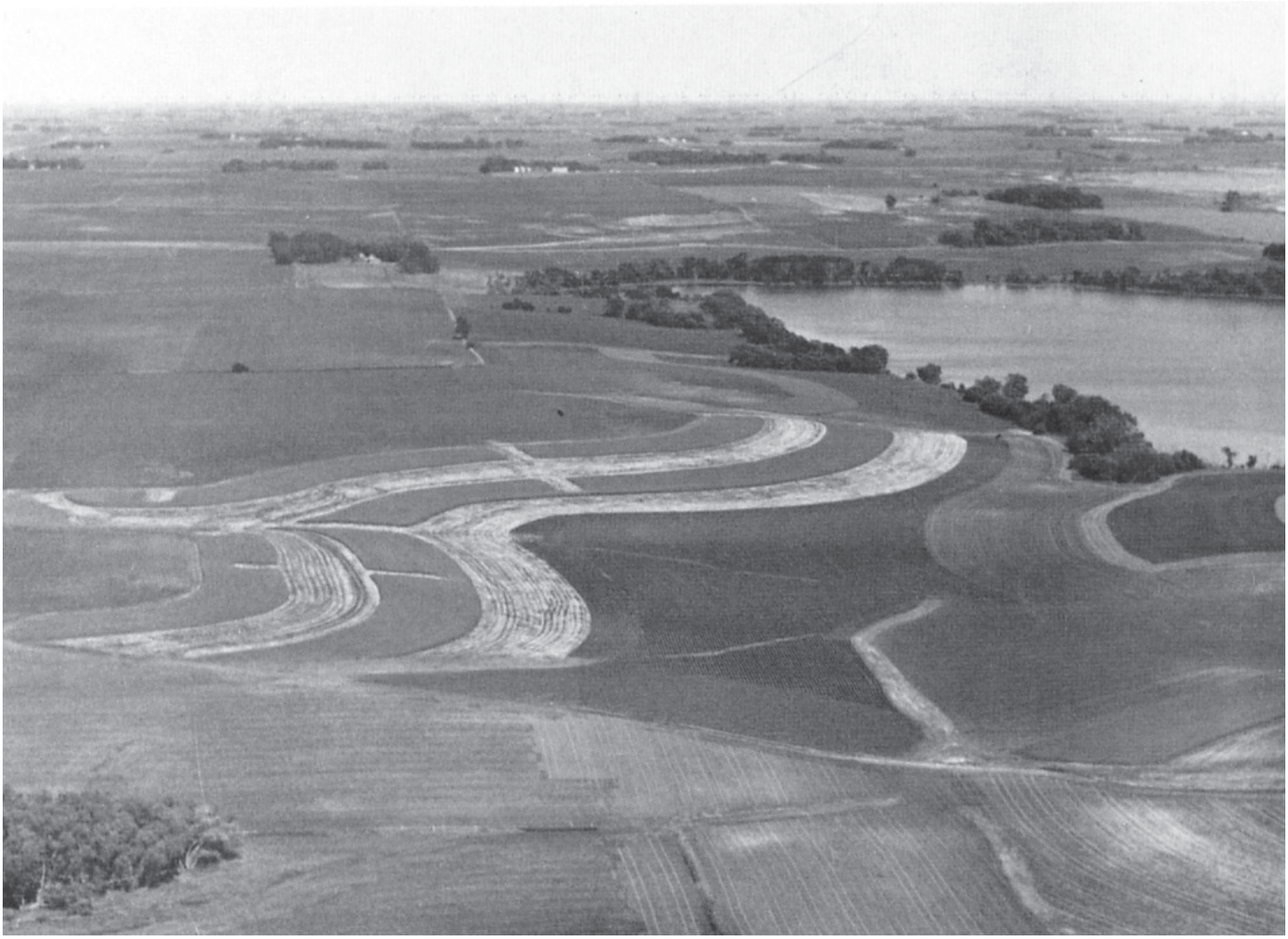
United States
Department of
Agriculture

Soil
Conservation
Service

In cooperation with
Minnesota Agricultural
Experiment Station

Soil Survey of Murray County, Minnesota



This page intentionally left blank.

How To Use This Soil Survey

General Soil Map

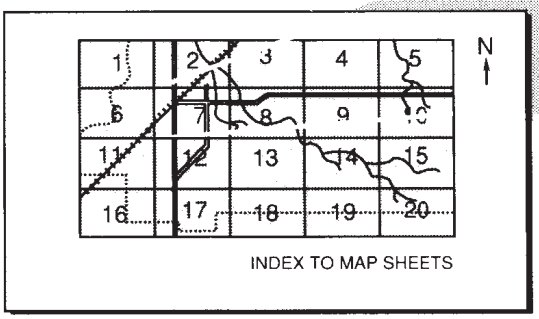
The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

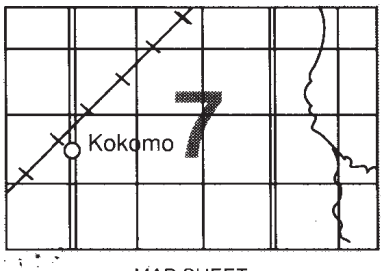
Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.

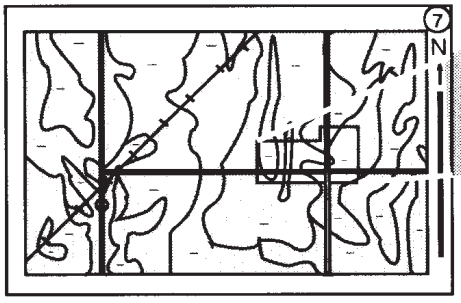


INDEX TO MAP SHEETS

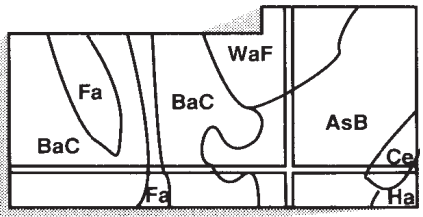


MAP SHEET

Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.



MAP SHEET



AREA OF INTEREST

NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1985. Soil names and descriptions were approved in 1987. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1985. This survey was made cooperatively by the Soil Conservation Service and the Minnesota Agricultural Experiment Station. It was partially funded by the Legislative Commission for Minnesota Resources and by Murray County. Other assistance was provided by the Minnesota Agricultural Extension Service, the Minnesota Soil and Water Conservation Board, and the Murray County Soil and Water Conservation District. The survey is part of the technical assistance furnished to the Murray County Soil and Water Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

All programs and services of the Soil Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

Cover: Contour stripcropping in an area of Storden and Clarion soils.

Contents

Issued October 1990

Index to Map Units

Summary of Tables

This page intentionally left blank.

Foreword

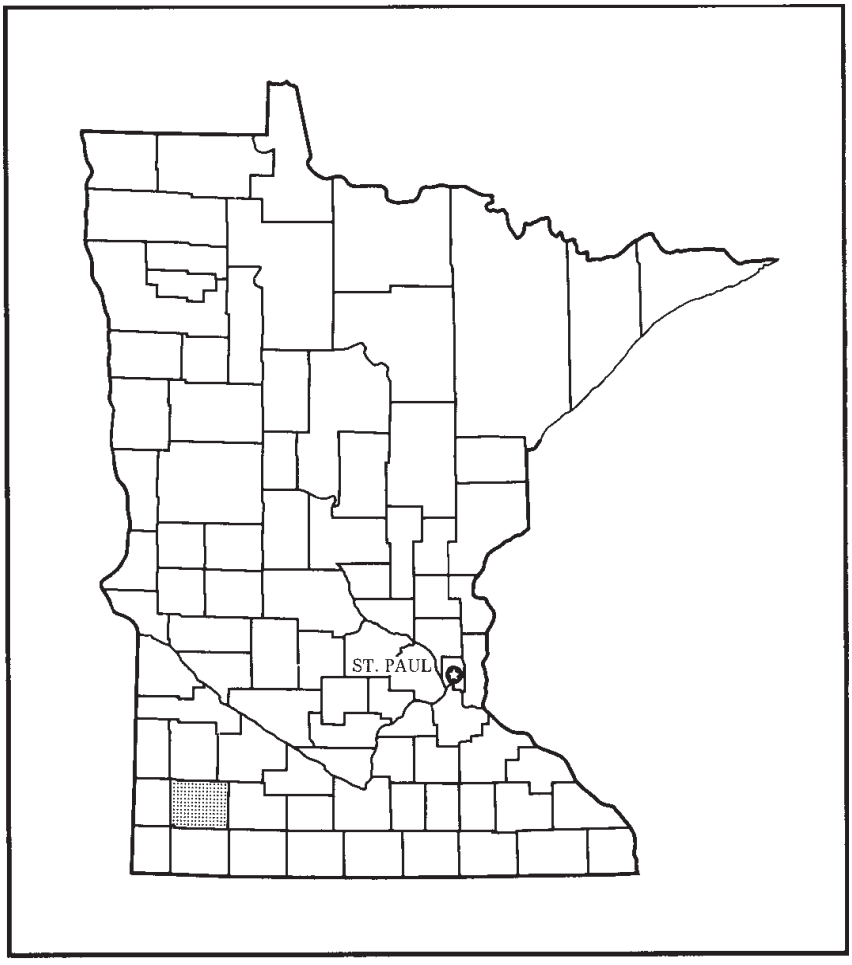
This soil survey contains information that can be used in land-planning programs in Murray County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

Gary R. Nordstrom
State Conservationist
Soil Conservation Service



Location of Murray County in Minnesota.

Soil Survey of Murray County, Minnesota

By Gary D. Nelson, Soil Conservation Service

Fieldwork by Hilding L. Hokanson and Gary D. Nelson, Soil Conservation Service, and William Gunnerson, Norman Kuhlman, and Roger Steinman, Minnesota Agricultural Experiment Station

United States Department of Agriculture, Soil Conservation Service,
in cooperation with
the Minnesota Agricultural Experiment Station

MURRAY COUNTY is in the southwestern part of Minnesota. It has a total land area of 449,700 acres. It is 30 miles from east to west and 24 miles from north to south. In 1980, it had a population of 11,507. The county has nine incorporated towns—Avoca, Chandler, Currie, Dovray, Fulda, Hadley, Iona, Lake Wilson, and Slayton. The county seat is Slayton. It had a population of 2,420 in 1980 and is the largest town in the county.

General Nature of the County

This section gives general information concerning the county. It describes history; climate; physiography, relief, and drainage; ground water resources; farming; and transportation facilities and markets.

History

The survey area was originally inhabited by the Plains Indians. Evidence of Indian activity, such as smoke signal pits and burial mounds, are numerous in the western part of the county. The first white men to enter the survey area were with J.B. Franquilan, who charted and mapped the Des Moines River in 1688. In 1833, the American Fur Company set up a trading post at Bear Lake. Murray County was officially established in 1857. It was named for William Pitt Murray, a legislator and member of the Committee on Counties.

Climate

Prepared by the National Climatic Data Center, Asheville, North Carolina.

Murray County is cold in winter and quite hot in summer. Occasional cool spells occur in summer. Precipitation frequently occurs as snowstorms during the winter. It occurs as showers during the warm months, when warm, moist air moves in from the south. The showers are often heavy. The total annual rainfall usually is adequate for corn, soybeans, and small grain.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Tracy in the period 1951 to 1980. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 16 degrees F, and the average daily minimum temperature is 6 degrees. The lowest temperature on record, which occurred at Tracy on January 16, 1972, is -32 degrees. In summer the average temperature is 71 degrees, and the average daily maximum temperature is 83 degrees. The highest recorded temperature, which occurred at Tracy on July 31, 1955, is 107 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly

accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 25 inches. Of this, more than 18 inches, or about 70 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 14 inches. The heaviest 1-day rainfall during the period of record was 3.8 inches at Tracy on October 31, 1979. Thunderstorms occur on about 44 days each year. Tornadoes and severe thunderstorms strike occasionally. These storms are local in extent and of short duration. They result in sparse damage in small areas. Hail occasionally falls in scattered small areas during the warmer periods.

The average seasonal snowfall is about 39 inches. The greatest snow depth at any one time during the period of record was 45 inches. On the average, 53 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 70 percent of the time possible in summer and 55 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 13 miles per hour, in spring.

Physiography, Relief, and Drainage

Murray County is on a plateau called the Coteau des Prairies, a wedge-shaped bedrock upland between the Minnesota River lowland and the James River lowland in South Dakota *(15)*. The Coteau des Prairies was covered with glacial drift as several continental ice sheets advanced and retreated during the Pleistocene, which began about 2 million years ago. The present landforms and surficial deposits are the result of the Des Moines lobe of the Late Wisconsin Glaciation, which ended about 10,000 years ago. The surface of Murray County is mostly a nearly level to undulating glacial moraine that is dissected by two nearly parallel, northwest- to southeast-trending end moraines that formed a rolling to steep topography (fig. 1).

Cretaceous-age sediments and Sioux Quartzite make up the bedrock surface of the drift-mantled Coteau des Prairies (fig. 2). Metamorphic and igneous crystalline Precambrian rocks underlie the Sioux Quartzite and Cretaceous rocks. Sioux Quartzite, a metamorphosed sedimentary sandstone, was deposited over part of the Precambrian rocks during what may have been an offshore sea deposition *(5)*. Quartzite bedrock extends diagonally across the county from the northwestern and west-central parts of the county to the southeastern part. Erosion-resistant Sioux Quartzite formed a preglacial regional topographic high, which controlled the deposition of Cretaceous sediments and glacial drift. The maximum thickness of the Sioux Quartzite in Murray County is about 1,200 feet *(3)*.

Cretaceous-age sediments overlie the Precambrian rocks and part of the Sioux Quartzite. Inland seas deposited these poorly consolidated sediments of marine and continental cretaceous shale and sandstone. The thickness of the Cretaceous bedrock in Murray County ranges from 50 to 500 feet *(6)*.

The thickness of glacial drift in the county ranges from about 200 to 600 feet. The thick mantle of glacial drift included drift deposited by glaciers that covered Murray County before the advance of the Des Moines lobe. The glacial drift is thickest in the southwestern part of the county, where it is between 400 and 600 feet thick. It is thinnest in the northeastern and southeastern parts of the county, where it is less than 200 feet thick.

Murray County is characterized by some marked relief caused by the activities of the Des Moines lobe as it withdrew from the Coteau des Prairies. Elevation ranges from more than 1,900 feet on the crest of the Coteau in Chanarambie Township to 1,250 on the Coteau slope in Holly Township. The Bemis Moraine is the main outer feature of the Des Moines lobe. It was deposited on the west side of the Coteau des Prairies. The moraine forms a regional topographic high that ranges in elevation from 1,700 to more than 1,900 feet. The Bemis Moraine is most strongly expressed in Cameron and Chanarambie Townships, where it is locally known as Buffalo Ridge. The moraine extends into Leeds Township, where it is locally known as Summit Hill. The highest point in the county, about 1,925 feet above sea level, is in section 21 of Chanarambie Township. Slopes are short, complex, and undulating to steep in the Buffalo Ridge and Summit Hill areas. The moraine extends through Moulton and Fenton Townships, where it is less well expressed and decreases in elevation. Slopes are short, complex, and nearly level to rolling.

A loess-covered ground moraine is southwest of the Bemis Moraine, on the inner part of the Coteau des Prairies, a regional topographic sag that slopes to the southwest. Elevation of the inner Coteau in Murray County ranges from about 1,600 to 1,800 feet, and the

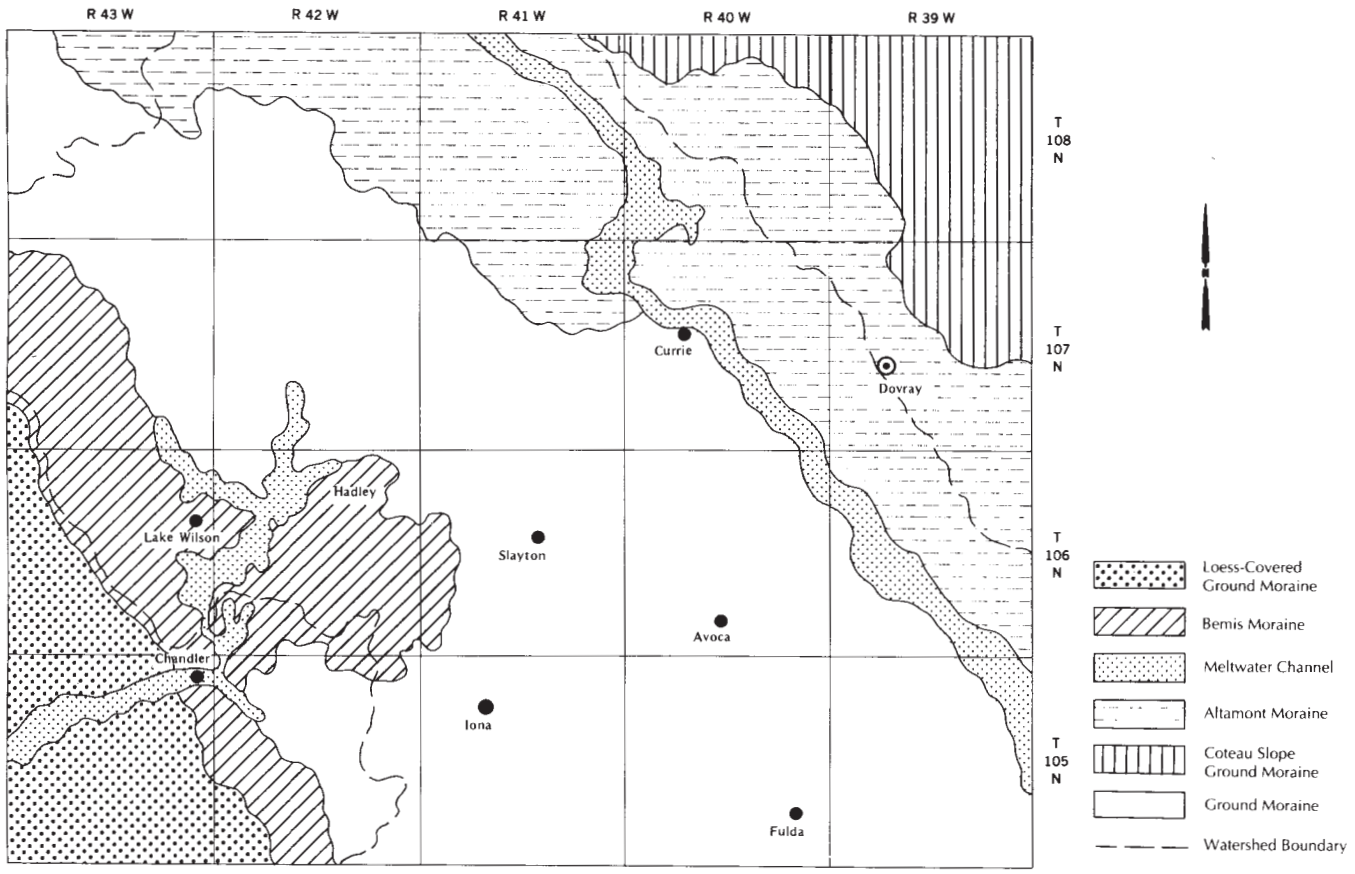


Figure 1.—The glacial topography of Murray County.

surface slopes to the southwest at about 30 feet per mile. Slopes are long, simple, and nearly level to moderately sloping.

A low-relief moraine is inside the Bemis Moraine on the crest of the Coteau. Elevation ranges from about 1,500 to 1,800 feet, and the surface slopes gradually to the northeast. Slopes are short, complex, and nearly level to undulating.

The Altamont Moraine, which is on the crest of the Coteau, is about 200 feet lower in elevation than the Bemis Moraine and is more of a slight swell, compared to the conspicuous ridgelike form of the Bemis Moraine. Slopes are short, complex, and generally undulating to hilly.

A low-relief moraine is inside the Altamont Moraine on the Coteau slope, the northeastern flank of the Coteau des Prairies. The surface of the Coteau slope ranges from about 1,200 to 1,500 feet in elevation and slopes to the northeast at about 30 feet per mile. Slopes are complex and generally are nearly level to undulating. They are longer than the slopes on the moraine between the Bemis and Altamont Moraines. The regional slope of the Coteau is toward the northeast. It is accentuated by the headward extension of streams from the Minnesota River Valley. Longer slopes have developed on this landscape.

Because of the young age of the landscape, most of Murray County has a poorly developed surface drainage pattern, as is indicated by streams that have few tributaries and by numerous undrained depressions and lakes. On the inner Coteau and on the Coteau slope, however, the regional slope of the landscape has allowed a more mature drainage system to develop. The county is drained by four watersheds. The watersheds of the Des Moines, Redwood, and Cottonwood Rivers drain into the Mississippi River drainage basin. The watershed of the Rock River drains into the Missouri River drainage basin. A system of county and judicial ditches has been developed to facilitate drainage of the watersheds of the Des Moines,

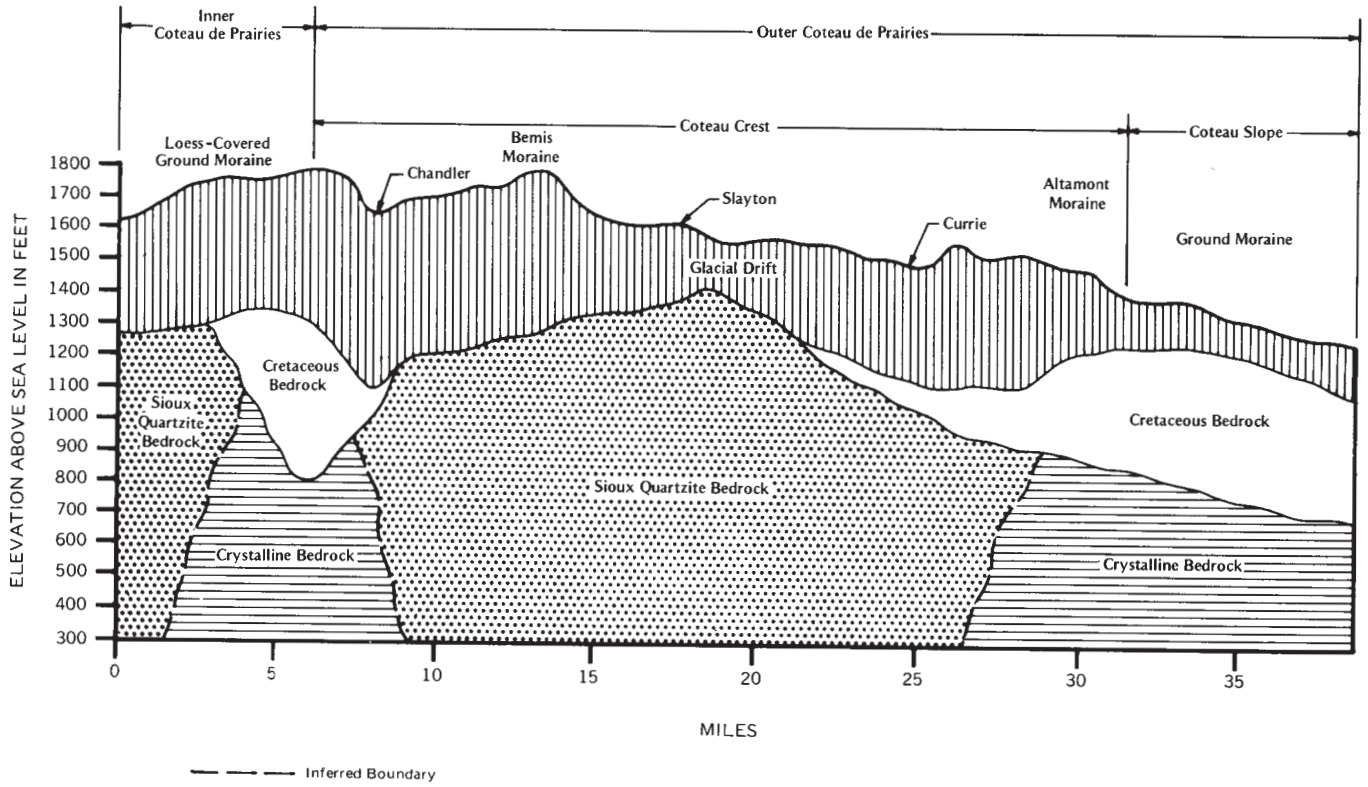


Figure 2.—Southwest-to-northeast cross-section of Murray County showing relative differences in elevation, thickness of glacial drift, and kinds of underlying rock.

Redwood, and Cottonwood Rivers. On a regional basis, the Bemis Moraine is the drainage divide between the Mississippi and Missouri River drainage basins. Generally, this moraine and the area to the west are well drained, having few lakes or wetlands. The area east of the Bemis Moraine is poorly drained, having many lakes and wetlands *(15)*.

About three-fourths of the county is drained to the southeast by the watershed of the Des Moines River. Beaver Creek drains most of Buffalo Ridge and Summit Hill and most of the ground moraine in the northwestern and central parts of the county. A network of ditches drains former lakebeds in Lowville and Skandi Townships. These ditches empty into Beaver Creek. The Altamont Moraine, in the north-central part of the county, is drained by small streams that empty into Lake Sarah, Lake Shetek, and numerous lakes that drain into Lake Shetek. Beaver Creek drains northeast through the ground moraine in the center of the county and joins the outlet of Lake Shetek northeast of Currie, forming the Des Moines River. The Des Moines River flows southeastward, following the course of a former glacial meltwater channel. Lime Creek drains Badger and Lime Lakes in the south-central part of the county and flows eastward, joining the Des Moines River in Des Moines River Township. Jack Creek drains a small area in the south-central part of the county. It flows south to the Des Moines River.

The watershed of the Cottonwood River drains the northeast corner of the county to the northeast, down the Coteau slope. The watershed includes all of the Coteau slope ground moraine and the northeast side of the Altamont Moraine, which extends through the northeastern part of the county. Headward extension of streams up the Coteau slope formed deeply incised, northeast-trending streams, such as Pell and Plum Creeks. The streams drained most of the depressional areas on the Coteau slope that were formed by glacial activity. Lake Julia and Lake Louisa form the headwaters of Dutch Charley Creek, which drains an area east of Dovray.

The watershed of the Redwood River drains a small area in the northwestern part of the county. The Redwood River meanders through the ground moraine

in the northwestern part of the county and through the Altamont Moraine and drains north out of the county.

The watershed of the Rock River drains the southwestern part of the county to the southwest, down the regional slope of the inner Coteau. The watershed breaks roughly on the crest of the Bemis Moraine, but it includes a ground moraine area in Fenton Township that is drained to the southwest as a result of the headward extension of Chanarambie Creek. This creek is the main drainageway on the watershed of the Rock River in Murray County. The creek flows through a gorgelike valley locally known as Chandler Valley, which was eroded by glacial meltwater. Chandler Valley is 100 to 150 feet deep and 1,000 to 4,500 feet wide at the bottom. Numerous small, deeply incised steams have extended headward up the steep slopes of the valley.

The channel that dissects Buffalo Ridge and Summit Hill east of Lake Wilson drained to the southwest through Chandler Valley during the melting of glacial ice. Drainage to the southwest through Chanarambi Creek ceased after the ice melted and drainage was established to the east by Beaver Creek.

The watershed of the Rock River is well drained in all areas, except for the ground moraine area in Fenton Township. Headward extension of streams from the Rock River formed an integrated drainage system that drained depressional areas formed by glacial activity.

Ground Water Resources

The availability and quality of ground water in Murray County are directly related to the thickness and type of glacial drift and type of bedrock. Ground water can be drawn from four types of aquifers—surficial deposits of glacial sand and gravel, buried deposits of glacial sand and gravel, Cretaceous-age bedrock, and Sioux Quartzite bedrock of Precambrian age. The ground water in the county generally is very hard and has high concentrations of dissolved solids.

Aquifers in the surficial deposits of glacial sand and gravel are generally along glacial meltwater channels or on small outwash plains on the Altamont Moraine. Wells in this aquifer are shallow, generally between 30 and 55 feet deep *(4)*. High yields of relatively good quality water, however, can be expected from these aquifers. The water is dominated by calcium, magnesium, and bicarbonate ions and is lower in content of dissolved solids than water from the buried deposits of sand and gravel because the surficial deposits are well leached. In farmed areas and in areas near feedlots, the aquifers in surficial sand and gravel are more likely to be contaminated than those in buried sand and gravel because they are exposed at the surface. Water from wells that are contaminated by surface sources have higher concentrations of chloride and nitrate than water from uncontaminated wells *(3)*.

Aquifers in the buried sand and gravel are in beds at various depths within the glacial drift. These aquifers are used mainly in areas of ground and end moraines. They can be used in meltwater and outwash areas, however, if a satisfactory source is not available in the surficial sand and gravel. Buried sand and gravel beds are the most accessible and widely used aquifers in the county. The aquifers are generally thin and discontinuous but provide adequate supplies for most uses. They provide most of the ground water in areas where the drift is more than 200 feet thick. A sand and gravel bed that provides a satisfactory water supply is more likely to be penetrated in areas of thicker drift with deposits of different age than in other areas. Moderate yields of water dominated by calcium, magnesium, and sulfate ions and high in content of dissolved solids can be expected from these aquifers. Most of the wells in buried sand and gravel aquifers range from 80 to 350 feet deep and average 180 feet deep *(3)*.

Cretaceous aquifers are thin layers of sandstone concentrated near the base of Cretaceous deposits. Intensive weathering during part of the Cretaceous period favored the decomposition of otherwise erosion-resistant Sioux Quartzite and crystalline rocks. Some of the sand-sized weathering products were transported and deposited, forming the Cretaceous aquifers. Cretaceous sediments are not continuous throughout the county. They do not occur in areas where Sioux Quartzite bedrock interfered with their deposition. These sediments range from 50 to 500 feet in thickness and are thickest in the northeastern part of the county. Few wells draw water from Cretaceous aquifers in Murray County. The sandstone is local in extent and is of secondary importance to the drift aquifers. The Cretaceous aquifers may be of primary importance, however, where drift less than 200 feet thick overlies Cretaceous sediments in the northeast corner of the county. Moderate yields of water high in content of dissolved solids and dominated by calcium, magnesium, and sulfate ions can be expected from these aquifers. Base exchange with sodium and potassium may soften the water in deep Cretaceous clays.

Sioux Quartzite aquifers are in the upper 100 to 300 feet of quartzite bedrock that may have loose sand zones, fractures, and joints in which water is available. Few of the wells in Murray County draw water from these aquifers. The aquifers are used only where thin

glacial drift directly overlies Sioux Quartzite. The best potential area for these aquifers is in the southern parts of Bondin and Belfast Townships, where drift less than 200 feet thick overlies Sioux Quartzite *(10)*. The quartzite aquifers are a potential source of reliable water, but they are not widely used because of the availability of the drift aquifers. Low or moderate yields of water dominated by calcium, magnesium, and sulfate ions and high in content of dissolved solids can be expected from the quartzite aquifers. Base exchange with sodium and potassium may result in some softening of water in deep glacial clay *(3)*.

Farming

About 92 percent of the land in the county is farmed. Corn, soybeans, small grain, and hay crops are grown throughout the county. Feeding cattle and hogs, raising livestock, and dairying also are major sources of income in the county. The trend is toward fewer and larger farms.

Corn is the most widely grown crop, followed by soybeans. The acreage of corn increased from 140,600 acres in 1970 to 172,500 acres in 1980. The acreage of soybeans during this 10-year period increased from 73,100 acres to 146,600 acres. The acreage of alfalfa decreased from 26,400 acres in 1970 to 20,100 acres in 1980, the acreage of oats from 39,600 acres in 1970 to 24,600 acres in 1980, and the acreage of pasture from 43,242 acres in 1972 to 34,618 acres in 1982.

The number of beef cows has remained constant. It was 10,200 in 1970 and 10,100 in 1980. The number of milk cows decreased from 10,700 in 1970 to 8,500 in 1980. The number of hogs, sows, and pigs increased from 100,200 in 1970 to 105,000 in 1980.

Transportation Facilities and Markets

The major highways in the county are paved with concrete or asphalt. About 190 miles of county roads are paved with asphalt. There are 1,008 miles of township and county gravel roads. U.S. Highway 59 crosses the county from north to south and serves the towns of Slayton, Avoca, and Fulda. Minnesota Highway 30 crosses the county from east to west and serves the towns of Dovray, Currie, Slayton, and Lake Wilson. Minnesota Highway 91 crosses the county from north to south. It intersects Minnesota Highway 30 at Lake Wilson. Minnesota Highway 62, in the southeastern part of the county, serves the town of Fulda. Minnesota Highway 267 serves the towns of Iona and Slayton.

Livestock is trucked to markets. Grain elevators are located in all of the towns in the county. The grain is transported to terminal markets by truck. Most of the milk produced in the county is marketed as whole milk and transported by truck to various markets outside the county.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, soil reaction, and other features that enable them to identify soils. After describing the soils in the survey area and

Figure 3.—A soil scientist checking the water table in an area of Collinwood silty clay, 0 to 2 percent slopes.

determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For

example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date (fig. 3).

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They are mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

General Soil Map Units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

As a result of changes in soil series concepts, different soil patterns, and variations in map unit design, some soil boundaries and names in this survey do not match those in the published soil surveys of Cottonwood, Nobles, and Pipestone Counties.

Soil Descriptions

Areas Dominated by Soils That Formed in Friable Glacial Till

These nearly level to very steep soils formed in medium textured to moderately fine textured, calcareous glacial till. The steeper soils are around some depressions and along streams and the larger drainageways. Most areas are used for cultivated crops. If cropped, the nearly level soils are limited by wetness and the more sloping soils are subject to water erosion.

1. Barnes-Flom-Vallers Association

Well drained and poorly drained, nearly level to moderately steep soils that formed in loamy glacial till

This association is mainly on irregular, complex slopes on undulating moraines. The elevation is one of the highest in the county. Drainage patterns are complex; the landscape has many closed depressions. Slopes range from 0 to 18 percent.

This association makes up about 26 percent of the county. It is about 35 percent Barnes soils, 20 percent Flom soils, 15 percent Vallers soils, and 30 percent soils of minor extent.

The Barnes soils are well drained and generally are undulating. They are on hilltops and side slopes. Typically, the surface layer is black loam about 9 inches thick. The subsoil is loam about 25 inches thick. The upper part is dark brown, and the lower part is dark yellowish brown. The underlying material to a depth of about 60 inches is olive brown, mottled loam.

The Flom soils are poorly drained and nearly level. They are in shallow drainageways and on low flats. Typically, the surface layer is black clay loam about 8 inches thick. The subsurface layer is clay loam about 15 inches thick. The upper part is black, and the lower part is very dark gray. The subsoil is olive gray, mottled clay loam about 10 inches thick. The underlying material to a depth of about 60 inches is light olive gray, mottled clay loam.

The Vallers soils are poorly drained and nearly level. They are on the edges of depressions, in drainageways, and on low flats. Typically, the surface layer is black clay loam about 8 inches thick. The subsurface layer also is black clay loam. It is about 7 inches thick. The next layer is very dark gray, mottled clay loam about 8 inches thick. The underlying material to a depth of about 60 inches is olive gray and grayish brown, mottled loam.

Of minor extent in this association are Buse, Svea, Terril, Quam, Oldham, Hamerly, and Sinai soils. The well drained Buse soils are on side slopes. The moderately well drained Svea soils are on concave side slopes and summits. The moderately well drained Terril soils are on foot slopes. The very poorly drained Quam soils are in shallow depressions. The very poorly

drained, calcareous Oldham soils are in drained lakebeds and closed depressions. The calcareous, moderately well drained Hamerly soils are on low rises within areas of poorly drained soils. The nearly level, moderately well drained Sinai soils formed in lacustrine sediments or glacial till on some of the highest parts of the landscape.

Most of the acreage is farmed. The main enterprises are growing cash crops, raising livestock, and feeding beef cattle and hogs. Corn, soybeans, small grain, and hay are the principal crops. Undrained areas of the poorly drained soils and frequently flooded areas on bottom land are used mainly as wildlife habitat or pasture.

This association generally is well suited to cultivated crops. Water erosion on the Barnes soils and wetness in the Flom and Vallers soils are the major management concerns. In many areas of the Barnes soils, slopes are too irregular or complex for contour farming. Applying a system of conservation tillage and including grasses and legumes in the crop rotation help to control erosion. Tile drains and surface ditches can remove the excess water in the Flom and Vallers soils.

Ponds constructed in the glacial till generally hold water satisfactorily. Borings are needed, however, to check for veins or pockets of sand or gravel, which would allow the water to seep away. Dugout pits in areas of the Flom soils generally supply an adequate amount of water for livestock.

2. Barnes-Buse Association

Well drained, gently undulating to very steep soils that formed in loamy glacial till

This association is mainly on irregular, complex slopes on end moraines. The elevation is one of the highest in the county. Drainage patterns are complex; the landscape has many short, deep drainageways. Slopes range from 2 to 40 percent.

This association makes up about 10 percent of the county. It is about 55 percent Barnes soils, 20 percent Buse soils, and 25 percent soils of minor extent.

The Barnes soils generally are gently undulating and undulating but are steeper in areas near the Buse soils. Typically, the surface layer is black loam about 9 inches thick. The subsoil is loam about 25 inches thick. The upper part is dark brown, and the lower part is dark yellowish brown. The underlying material to a depth of about 60 inches is olive brown loam.

The Buse soils are steep and very steep. The steep areas are intermingled with areas of the Barnes soils. Typically, the surface layer is very dark gray loam about 7 inches thick. The subsoil is dark yellowish brown loam about 15 inches thick. The underlying material to a depth of about 60 inches is yellowish brown and light olive brown loam and clay loam.

Of minor extent in this association are Svea, Terril, Quam, Vallers, Flom, and Hamerly soils. The moderately well drained Svea soils are on concave side slopes and summits. The moderately well drained Terril soils are on foot slopes. The very poorly drained Quam soils are in shallow depressions. The calcareous, poorly drained Vallers soils are on the edges of depressions. The poorly drained Flom soils are in shallow drainageways and on flats. The calcareous, moderately well drained Hamerly soils are on low rises within areas of poorly drained soils.

Most of the acreage is cultivated. The main enterprises are growing cash crops, raising livestock, and feeding hogs. Corn, soybeans, small grain, and hay are the principal crops. The steeper areas are used dominantly as pasture or wildlife habitat.

This association generally is well suited or fairly well suited to cultivated crops. Water erosion is the main management concern. In most areas the slopes are too irregular or too complex for contour farming. Applying a system of conservation tillage and including grasses and legumes in the crop rotation help to control erosion.

Ponds can be constructed along the small streams and bottom land that dissect the steeply sloping areas. Ponds constructed in glacial till generally hold water satisfactorily. Borings are needed, however, to check for small veins or pockets of sand and gravel, which would allow the water to seep away.

3. Clarion-Webster-Nicollet Association

Well drained, poorly drained, and moderately well drained, nearly level to hilly soils that formed in loamy glacial till

This association is mainly on convex slopes on moraines at the lower elevations in the county. The landscape is characterized by shallow, low-gradient swales and by narrow flats at the head of drainageways. Slopes range from 0 to 18 percent.

This association makes up about 21 percent of the county. It is about 35 percent Clarion soils, 20 percent Webster soils, 15 percent Nicollet soils, and 30 percent soils of minor extent (fig. 4). The Clarion soils are well drained. They are gently undulating on convex hilltops and undulating to hilly on side slopes. Typically, the surface layer is black loam about 8 inches thick. The subsurface layer is very dark grayish brown loam about 4 inches thick. The subsoil is brown loam about 11

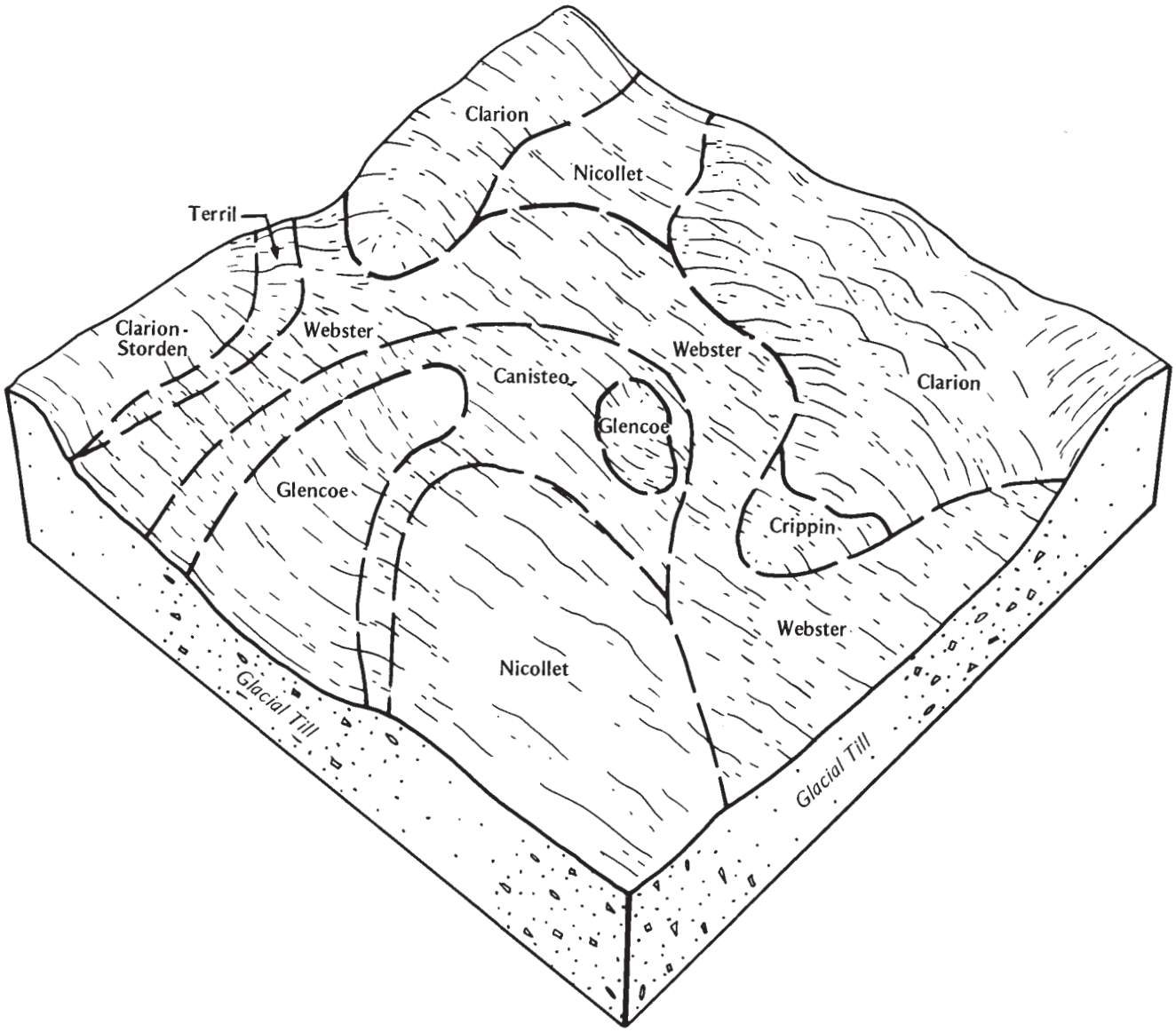


Figure 4.—Pattern of soils and parent material in the Clarion-Webster-Nicollet association.

inches thick. The underlying material to a depth of about 60 inches is yellowish brown loam. It is mottled in the lower part.

The Webster soils are nearly level and poorly drained. They are on low flats and in drainageways. Typically, the surface layer is black clay loam about 20 inches thick. The subsoil is very dark gray and dark grayish brown, mottled clay loam about 10 inches thick. The underlying material to a depth of about 60 inches is olive gray, mottled clay loam and loam.

The Nicollet soils are nearly level and moderately well drained. They are on slightly concave hilltops and side slopes. Typically, the surface layer is black loam about 9 inches thick. The subsurface layer is very dark brown loam about 7 inches thick. The subsoil is mottled loam about 12 inches thick. It is dark brown in the upper part and dark grayish brown in the lower part. The underlying material to a depth of about 60 inches is light olive brown, mottled loam.

Of minor extent in this association are Glencoe,

Canisteo, Terril, Crippin, and Storden soils. The very poorly drained Glencoe soils are in shallow, closed depressions. The poorly drained, calcareous Canisteo soils are on the rims of depressions and on low flats. The moderately well drained Terril soils are on foot slopes. The calcareous, somewhat poorly drained Crippin soils are on low rises and peninsulas within areas of poorly drained soils. The calcareous, well drained, rolling to very steep Storden soils are on side slopes.

Most of the acreage is farmed. The main enterprises are growing cash crops, raising hogs, and feeding beef cattle. Corn and soybeans are the principal crops. A few undrained areas of poorly drained soils and a few steep areas on the side slopes of drainageways are used as pasture or wildlife habitat.

This association generally is well suited to cultivated crops. Water erosion on the Clarion soils and wetness in the Webster soils are the major management concerns. The Nicollet soils have no major limitations, but soil blowing is a problem if no crop residue is left on the surface when fields are plowed. Contour farming and terraces help to control erosion on the Clarion soils. Conservation tillage helps to control erosion and soil blowing on the Clarion and Nicollet soils. Tile drains and open ditches can remove the excess water in the Webster soils.

4. Clarion-Storden Association

Well drained, undulating to very steep soils that formed in loamy glacial till

This association is on complex, undulating and steep knolls and very steep side slopes along streams on end moraines. The elevation is generally less than 1,600 feet. Runoff is rapid on the steep knolls. Short, incised drainageways are common. Slopes range from 2 to 40 percent.

This association makes up about 8 percent of the county. It is about 60 percent Clarion soils, 20 percent Storden soils, and 20 percent soils of minor extent.

The Clarion soils are mainly undulating to moderately steep. They are on hilltops and side slopes. Typically, the surface layer is black loam about 8 inches thick. The subsurface layer is very dark grayish brown loam about 4 inches thick. The subsoil is brown loam about 11 inches thick. The underlying material to a depth of about 60 inches is yellowish brown loam. It is mottled in the lower part.

The Storden soils are rolling and hilly on ridges and knolls and are steep and very steep on the side slopes along incised streams. Typically, the surface layer is dark grayish brown loam about 9 inches thick. The underlying material to a depth of about 60 inches is olive brown and light olive brown loam and clay loam.

Of minor extent in this association are Terril, Webster, Glencoe, Canisteo, Nicollet, and Crippin soils. The moderately well drained Terril soils are on foot slopes. The poorly drained Webster soils are in swales. The very poorly drained Glencoe soils are in closed depressions. The poorly drained, calcareous Canisteo soils are on the rims of depressions and on low flats. The moderately well drained Nicollet soils are on concave side slopes and summits. The calcareous, somewhat poorly drained Crippin soils are on low, slightly convex rises and peninsulas within areas of poorly drained soils.

Most of the acreage is cropped. The main enterprises are growing cash crops, raising livestock, and feeding hogs. Corn, soybeans, small grain, and hay are the principal crops. The steeper areas are used dominantly as pasture or wildlife habitat.

This association generally is well suited or fairly well suited to cultivated crops. Water erosion is the main management concern. Contour farming and water-control structures help to control erosion in areas where the slopes are suitable for these measures. In some areas where the slopes are too irregular for contour farming, erosion can be controlled by applying a system of conservation tillage and including grasses and legumes in the crop rotation.

Ponds are constructed in the small drainageways that dissect the steeply sloping areas. Ponds constructed in glacial till generally hold water satisfactorily. Borings are needed, however, to check for small veins or pockets of sand or gravel, which would allow the water to seep away.

Areas Dominated by Soils That Formed in Friable and Firm Glacial Till

These nearly level to moderately steep soils formed in friable, moderately fine textured, calcareous glacial till over firm, medium textured and moderately fine textured, calcareous glacial till. Nearly all areas are used for cultivated crops. If cropped, the nearly level soils are limited by wetness and the more sloping soils are subject to water erosion.

5. Everly-Letri-Wilmonton Association

Well drained, poorly drained, and moderately well drained, nearly level to moderately steep soils that formed in loamy glacial till

This association is in slightly convex and plane areas

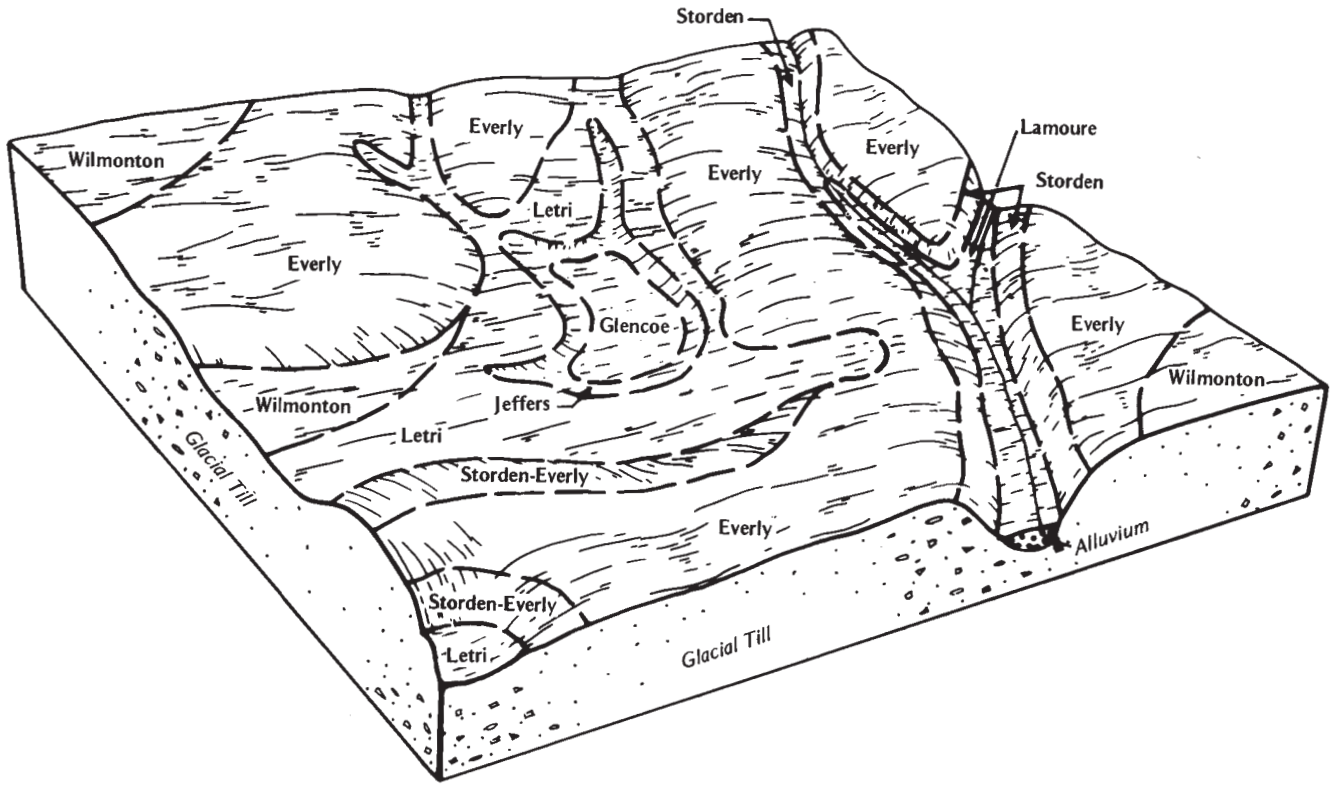


Figure 5.—Pattern of soils and parent material in the Everly-Letri-Wilmonton association.

on moraines. In a few areas it is rolling to moderately steep. The steeper areas are mainly along deep drainageways and streams that dissect the association in a northeasterly direction. Slopes range from 0 to 14 percent.

This association makes up about 7 percent of the county. It is about 45 percent Everly soils, 20 percent Letri soils, 15 percent Wilmonton soils, and 20 percent soils of minor extent (fig. 5).

The Everly soils are well drained and are gently undulating to moderately steep. They are on hilltops and side slopes. Typically, the surface layer is black clay loam about 9 inches thick. The next layer is very dark gray and dark brown clay loam about 4 inches thick. The subsoil is about 18 inches thick. The upper part is dark yellowish brown clay loam, and the lower part is brown loam. The underlying material to a depth of about 60 inches is yellowish brown loam.

The Letri soils are nearly level and poorly drained. They are in drainageways and on low flats. Typically, the surface layer is black clay loam about 20 inches thick. The subsoil is mottled clay loam about 14 inches thick. The upper part is dark grayish brown and friable, and the lower part is olive gray and firm. The underlying material to a depth of about 60 inches is light brownish gray, mottled loam.

The Wilmonton soils are nearly level and moderately well drained. They are on plane and slightly concave hilltops and in long, narrow areas adjacent to drainageways. Typically, the surface layer is black clay loam about 8 inches thick. The subsurface layer is very dark gray clay loam about 7 inches thick. The subsoil is very dark grayish brown clay loam about 9 inches thick. Very dark gray worm casts are common in the upper part of the subsoil, and grayish brown mottles are common in the lower part. The underlying material to a depth of about 60 inches is light olive brown and light yellowish brown, mottled clay loam.

Of minor extent in this association are Storden, Glencoe, Jeffers, Lamoure, and La Prairie soils. The well drained, steep and very steep Storden soils are along the deep drainageways that dissect the association. The very poorly drained Glencoe soils are in shallow, closed depressions. The poorly drained,

calcareous Jeffers soils are on the edges of closed depressions and on flats. The poorly drained Lamoure and moderately well drained La Prairie soils are along Plum Creek and in some drainageways.

Most of the acreage is farmed. The main enterprises are growing cash crops, raising livestock, and feeding hogs. Corn and soybeans are the principal crops. The steep side slopes and frequently flooded areas on narrow bottom land along drainageways are used as pasture or wildlife habitat.

This association generally is well suited to cultivated crops. Wetness in the Letri soils and the hazard of water erosion on the Everly soils are the major management concerns. The Wilmonton soils have no major limitations, but soil blowing is a problem if no crop residue is left on the surface when fields are plowed. Tile drains remove the excess water in the Letri soils. Contour farming and terraces help to control water erosion on the Everly soils. Conservation tillage reduces the hazard of soil blowing on the Everly and Wilmonton soils.

Ponds constructed in the glacial till generally hold water satisfactorily. Borings are needed, however, to check for veins or pockets of sand or gravel, which would allow the water to seep away.

Areas Dominated by Soils That Formed in Glaciolacustrine Sediments or Glacial Till

These soils formed dominantly in silty lacustrine sediments or in glacial till. They generally are nearly level and gently sloping but in some areas are sloping. Nearly all areas are used for cultivated crops. If cropped, the nearly level soils have few or no limitations and the more sloping soils are subject to water erosion.

6. Collinwood-Clarion-Waldorf Association

Moderately well drained, well drained, and poorly drained, nearly level to sloping soils that formed in clayey lacustrine sediments or loamy glacial till

This association is mainly on nearly level, slightly convex slopes and on flats, but some areas are on convex, undulating slopes. The water-worked glacial sediments were deposited over a complex topography of glacial till, forming a smoother, gently sloping landscape with broad, flat drainageways and meandering streams. In some areas on the undulating slopes, the glacial till is not overlain by lacustrine sediments. Slopes range from 0 to 12 percent.

This association makes up about 12 percent of the county. It is about 30 percent Collinwood soils, 25 percent Clarion soils, 15 percent Waldorf soils, and 30 percent soils of minor extent (fig. 6).

The Collinwood soils are nearly level and undulating and are moderately well drained. They are on slightly concave hilltops and in nearly level areas. Typically, the surface layer is black silty clay about 8 inches thick. The subsurface layer is silty clay about 10 inches thick. It is black in the upper part and very dark gray in the lower part. The subsoil is dark grayish brown silty clay about 16 inches thick. It is mottled in the lower part. The underlying material to a depth of about 60 inches is grayish brown, mottled silty clay.

The Clarion soils are gently undulating and rolling and are well drained. They are on side slopes. Typically, the surface layer is black loam about 8 inches thick. The subsurface layer is very dark grayish brown loam about 4 inches thick. The subsoil is brown loam about 11 inches thick. The underlying material to a depth of about 60 inches is yellowish brown loam. It is mottled in the lower part.

The Waldorf soils are nearly level and poorly drained. They are in drainageways and on low flats. Typically, the surface layer is black silty clay about 8 inches thick. The subsurface layer also is black silty clay. It is about 13 inches thick. It is mottled in the lower part. The subsoil is olive gray, mottled silty clay about 21 inches thick. The underlying material to a depth of about 60 inches is light olive gray, mottled silty clay.

Of minor extent in this association are Lura, Spicer, Nicollet, Storden, Canisteo, and Glencoe soils. The very poorly drained Lura soils formed in lacustrine material in depressions. The poorly drained, calcareous Spicer soils formed in lacustrine material on the rims of depressions and on broad flats. The nearly level, moderately well drained Nicollet soils formed in glacial till on concave side slopes. The well drained Storden soils are on convex side slopes. The calcareous, poorly drained Canisteo soils formed in glacial till on the edges of depressions. The very poorly drained Glencoe soils formed in glacial till in the depressions.

Most of the acreage is farmed. The main enterprises are growing cash crops, raising hogs, and feeding beef cattle. Corn and soybeans are the principal crops. A few undrained areas of poorly drained soils are used as pasture or wildlife habitat.

This association generally is well suited to cultivated crops. Wetness in the Waldorf soils, soil blowing on the Collinwood soils, and water erosion on the Clarion soils are the major management concerns. Tile drains and open ditches remove the excess water in the Waldorf soils. Conservation tillage helps to control soil blowing

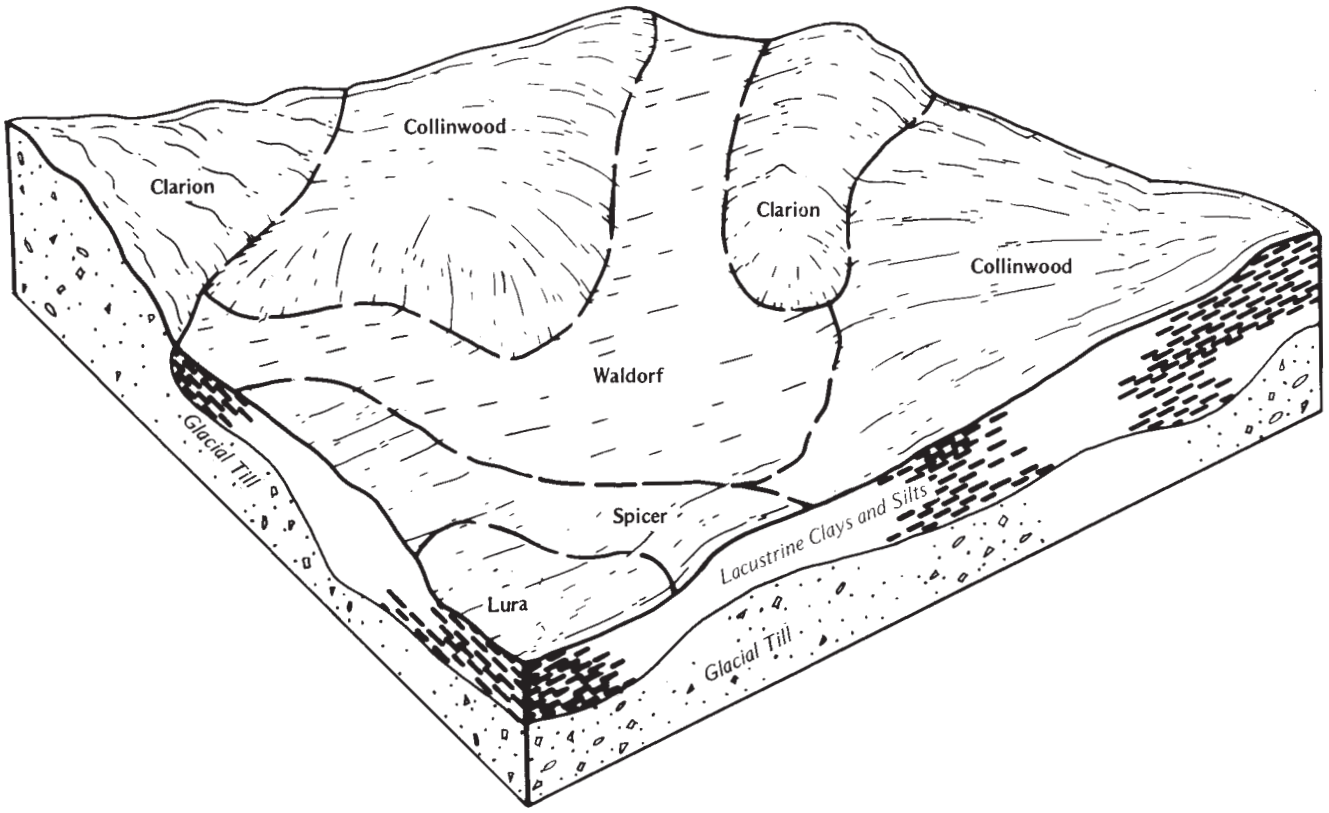


Figure 6.—Pattern of soils and parent material in the Collinwood-Clarion-Waldorf association.

and water erosion on the Collinwood and Clarion soils. Contour farming and terraces also help to control water erosion on the Clarion soils.

Areas Dominated by Soils That Formed in Loess and Glacial Till

These soils formed in wind-deposited, silty material and loamy glacial till on uplands. They generally are gently undulating and nearly level, but steep and very steep areas are along the incised drainageways that dissect the landscape. Most areas are used for cultivated crops. If cropped, the nearly level and gently undulating soils have few limitations and the steeper soils are subject to water erosion.

7. Vienna-Hidewood-Lismore Association

Well drained, poorly drained, and moderately well drained. nearly level to hilly soils that formed in silty loess and in glacial till

This association is on long slopes on loess-mantled ground moraines. The complex topography of the underlying glacial till was filled in and leveled when loess was deposited. Smooth, convex slopes are dissected by broad, low-gradient drainageways. The drainageways are incised into the underlying glacial till. Slopes range from 0 to 15 percent.

This association makes up about 8 percent of the county. It is about 45 percent Vienna soils, 15 percent Hidewood soils, 15 percent Lismore soils, and 25 percent soils of minor extent.

The Vienna soils are gently sloping to hilly and are well drained. They are on long, convex slopes. Typically, the surface layer is black silty clay loam about 10 inches thick. The subsoil is about 17 inches thick. It is dark brown silty clay loam in the upper part, dark yellowish brown clay loam in the next part, and dark yellowish brown and pale brown clay loam in the lower part. The underlying material to a depth of about 60 inches is yellowish brown and pale brown clay loam.

The Hidewood soils are nearly level and poorly drained. They are in drainageways and on low flats.

Typically, the surface layer is silty clay loam about 8 inches thick. The subsurface layer is silty clay loam about 13 inches thick. It is black in the upper part and very dark gray in the lower part. The subsoil is grayish brown, mottled silty clay loam about 10 inches thick. The underlying material to a depth of about 60 inches is olive and light olive gray, mottled loam and clay loam.

The Lismore soils are nearly level and moderately well drained. They are on plane and slightly concave side slopes and in the upper part of drainageways. Typically, the surface layer is black silty clay loam about 8 inches thick. The subsurface layer also is black silty clay loam. It is about 7 inches thick. The subsoil is clay loam about 16 inches thick. It is very dark grayish brown in the upper part and dark grayish brown in the lower part. The underlying material to a depth of about 60 inches is light olive brown clay loam.

Of minor extent in this association are Buse and Terril soils. The well drained Buse soils are on the steep side slopes of drainageways and in swales. The moderately well drained Terril soils are on foot slopes.

Most of the acreage is farmed. The main enterprises are growing cash crops, dairying, and feeding beef cattle and hogs. Corn, soybeans, small grain, and hay are the principal crops. The steep side slopes and frequently flooded bottom land are used mainly as pasture or wildlife habitat.

This association generally is well suited to cultivated crops. Water erosion and soil blowing are the major management concerns on the Vienna and Lismore soils. Wetness in the Hidewood soils is an additional concern. Contour farming and terraces help to control water erosion on the Vienna soils. Conservation tillage reduces the hazard of soil blowing on the Lismore and Vienna soils.

Ponds constructed in the underlying glacial till generally hold water satisfactorily. Borings are needed, however, to check for veins or pockets of sand or gravel, which would allow the water to seep away.

Areas Dominated by Soils That Formed in Glacial Outwash and Alluvium

These nearly level to moderately steep soils formed in moderately coarse textured and medium textured material over sandy and gravelly outwash. The soils are used as pasture or cropland. Droughtiness and soil blowing are the main management concerns.

8. Arvilla-Egeland-Marysland Association

Somewhat excessively drained, well drained, and poorly drained, nearly level to moderately steep soils that formed in loamy material over sandy and gravelly deposits

This association is in convex and plane areas on river terraces, in overflow channels, on outwash plains, and on moraines. In places the outwash is less than 4 feet thick and is underlain by glacial till or silty sediments. Slopes range from 0 to 15 percent.

This association makes up about 7 percent of the county. It is about 35 percent Arvilla soils, 25 percent Egeland soils, 10 percent Marysland soils, and 30 percent soils of minor extent.

The Arvilla soils are somewhat excessively drained. They are nearly level to sloping on stream terraces and outwash plains and generally are undulating on moraines. They are on knolls and side slopes. Typically, the surface layer is very dark gray sandy loam about 8 inches thick. The subsoil is dark brown sandy loam about 11 inches thick. The underlying material to a depth of about 60 inches is pale brown and light yellowish brown gravelly coarse sand.

The Egeland soils are well drained. They are nearly level and gently sloping on stream terraces and undulating on uplands. Typically, the surface layer is very dark gray sandy loam about 9 inches thick. The subsoil is about 24 inches thick. It is yellowish brown. It is sandy loam in the upper part and loamy sand in the lower part. The underlying material to a depth of about 60 inches is yellowish brown loamy fine sand.

The Marysland soils are nearly level and poorly drained. They are on low flats, in meltwater channels, and in overflow channels. Typically, the surface layer is loam about 17 inches thick. It is black in the upper part and very dark gray in the lower part. The upper part of the underlying material is grayish brown and olive gray, mottled loam. The lower part to a depth of about 60 inches is grayish brown, mottled gravelly coarse sand.

Of minor extent in this association are Fordville, Sverdrup, Sioux, Biscay, Buse, and Storden soils. The well drained Fordville soils are on stream terraces. The well drained Sverdrup soils are on side slopes and knolls. The excessively drained Sioux soils are very shallow to gravel. They are on terrace escarpments along streambeds, on lakeshores, and on gravelly ridges. The poorly drained Biscay soils are in swales. The well drained Buse and Storden soils are on steep side slopes along streambanks.

The main enterprises in areas of this association are growing cash crops, raising livestock, and feeding hogs and beef cattle. Small grain, hay, corn, and soybeans are the main crops.

This association is well suited to pasture and hay

and is fairly well suited or poorly suited to cultivated crops. Droughtiness and soil blowing are the major management concerns. Water erosion is an additional concern in the sloping and moderately steep areas. Soil blowing can be severe, especially where the soils have been fall plowed. Applying a system of conservation tillage and leaving crop residue on the surface reduce the hazards of water erosion and soil blowing and conserve moisture. Irrigation can improve crop production where an adequate water source is available.

9. Lamoure-La Prairie Association

Poorly drained and moderately well drained, nearly level soils that formed in silty and loamy alluvial material

This association is in long, narrow areas on flood plains. In places deposits of outwash sand and gravel are intermingled with the silty alluvial sediments. Slopes range from 0 to 2 percent.

This association makes up about 1 percent of the county. It is about 60 percent Lamoure soils, 20 percent La Prairie soils, and 20 percent soils of minor extent.

The Lamoure soils are poorly drained. They generally are on the lower parts of the flood plains. Typically, the surface layer is black silty clay loam about 11 inches thick. The subsurface layer is silty clay loam about 29 inches thick. It is black in the upper part and very dark gray in the lower part. The underlying material to a depth of about 60 inches is dark gray, mottled silty clay loam.

The La Prairie soils are moderately well drained. They are on the slightly higher parts of the flood plains. Typically, the surface layer is very dark gray loam about 13 inches thick. The subsurface layer also is very dark gray loam. It is about 12 inches thick. The subsoil is very dark grayish brown loam about 11 inches thick. The underlying material to a depth of about 60 inches is dark grayish brown loam.

Of minor extent in this association are Biscay, Marysland, Fordville, Sverdrup, and Arvilla soils. The poorly drained Biscay soils and the poorly drained, calcareous Marysland soils are in overflow channels and on the low parts of the flood plains. They are underlain by sand and gravel. The well drained Fordville and Sverdrup and somewhat excessively drained Arvilla soils are on stream terraces.

The main enterprises in areas of this association are growing crops, raising livestock, dairying, and feeding hogs and beef cattle. Corn and soybeans are the chief crops. Small grain is grown in a few areas. Some areas that are frequently flooded or are too wet for crops are used as pasture or wildlife habitat.

Where artificial drainage and flood control are feasible, this association is well suited to cultivated crops. The Lamoure soils have a seasonal high water table and are occasionally or frequently flooded. The La Prairie soils are occasionally flooded. The flooding usually occurs in the spring. About once every 10 years, it occurs during the growing season, when it damages crops.

This page intentionally left blank.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Arvilla sandy loam, 0 to 2 percent slopes, is a phase of the Arvilla series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Buse-Barnes loams, 12 to 18 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. The Pits part of the Pits, gravel-Udorthents complex is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

As a result of changes in soil series concepts, different soil patterns, and variations in map unit design, some soil boundaries and names in this survey do not match those in the published soil surveys of Cottonwood, Nobles, and Pipestone Counties.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Soil Descriptions

31F—Storden loam, 18 to 40 percent slopes. This steep and very steep, well drained soil is on moraines and till plains. It is on ridges and side slopes along streams and in drainageways and around the edges of ponds and lakes. Individual areas are long and narrow and range from 3 to 75 acres in size.

Typically, the surface layer is dark grayish brown loam about 9 inches thick. The underlying material to a depth of about 60 inches is olive brown and light olive brown loam and clay loam.

Included with this soil in mapping are small areas of the moderately well drained Terril soils on the concave parts of foot slopes. Also included are small areas of

Lamoure, La Prairie, and Webster soils in drainageways. Lamoure and La Prairie soils are subject to flooding. Webster soils are poorly drained. Included soils make up about 2 to 10 percent of the unit.

Permeability is moderate in the Storden soil. Available water capacity is high. Organic matter content is moderately low. Surface runoff is rapid.

Most of the acreage is idle land. This soil generally is unsuited to cultivated crops because of the hazard of water erosion and the slope.

The land capability classification is VIIe.

33B—Barnes loam, 2 to 4 percent slopes. This gently undulating, well drained soil is on convex hilltops and side slopes on moraines. Individual areas are about 100 to 175 feet long and range from 3 to 200 acres in size.

Typically, the surface layer is black loam about 9 inches thick. The subsoil is loam about 25 inches thick. The upper part is dark brown, and the lower part is dark yellowish brown. The underlying material to a depth of about 60 inches is olive brown, mottled loam.

Included with this soil in mapping are small areas of the more sloping, eroded Barnes soils and small areas of Svea, Hamerly, Flom, and Quam soils. The moderately well drained Svea soils are on foot slopes and in slightly concave areas. The moderately well drained, calcareous Hamerly soils are on slight rises and low, convex peninsulas. The poorly drained Flom soils are in shallow drainageways, and the very poorly drained Quam soils are in closed depressions. Also included are small areas of sandy and gravelly soils. Included soils make up about 10 to 15 percent of the unit.

Permeability is moderate in the Barnes soil. Available water capacity is high. Surface runoff is medium. Organic matter content is moderate or high.

This soil is used mainly for cultivated crops. It is well suited to most of the crops commonly grown in the county. Water erosion is the main hazard. Stones are sometimes moved to the surface by tillage and by frost action. The soil can be tilled more easily if the stones are removed periodically. Conservation tillage practices, such as chisel plowing, help to control erosion. Leaving crop residue on the surface and keeping the surface rough reduce the risk of soil blowing on fall-tilled fields during winter and spring. Grassed waterways are needed in areas where runoff flows across this soil.

The land capability classification is IIe.

33B2—Barnes loam, 3 to 6 percent slopes, eroded. This undulating, well drained soil is on convex side slopes on moraines. Erosion has exposed the subsoil in places. Individual areas are about 75 to 125 feet long and range from 3 to 150 acres in size.

Typically, the surface layer is very dark grayish brown loam about 9 inches thick. The subsoil is loam about 26 inches thick. It is brown in the upper part and dark yellowish brown in the lower part. The underlying material to a depth of about 60 inches is olive brown loam.

Included with this soil in mapping are small areas of the less sloping Barnes soils and small areas of Buse, Svea, and Flom soils. The well drained Buse soils are on the most exposed, steepest side slopes. They have a thin, light colored, calcareous surface layer. The moderately well drained Svea soils are on foot slopes and in slightly concave areas. The poorly drained Flom soils are in shallow drainageways. Also included are small areas of sandy, gravelly, or stony soils. Included soils make up about 5 to 15 percent of the unit.

Permeability is moderate in the Barnes soil. Available water capacity is high. Surface runoff is medium. Organic matter content is moderate.

This soil is used mainly for cultivated crops. It is well suited to most of the crops commonly grown in the county. Water erosion is the main hazard. Stones are sometimes moved to the surface by tillage and by frost action. The soil can be tilled more easily if the stones are removed periodically. The hazard of further water erosion is moderate. Where the slopes are suitable, erosion can be controlled by terraces and contour farming. Conservation tillage practices, such as chisel plowing, also help to control erosion. Leaving crop residue on the surface and keeping the surface rough reduce the risk of soil blowing on fall-tilled fields during winter and spring. In some areas tilth is poor because of a loss of organic matter through erosion. Including green manure or sod crops in the cropping sequence improves soil structure and tilth. Grassed waterways are needed in areas where runoff flows across this soil.

The land capability classification is IIe.

36—Flom clay loam. This nearly level, poorly drained soil is in drainageways and on low flats on moraines. Individual areas are irregular in shape and range from 3 to several hundred acres in size.

Typically, the surface layer is black clay loam about 8 inches thick. The subsurface layer is clay loam about 15 inches thick. The upper part is black, and the lower part is very dark gray. The subsoil is olive gray, mottled clay loam about 10 inches thick. The underlying material to a depth of about 60 inches is light olive gray, mottled clay loam. Some areas are briefly flooded when the snow

melts in the spring or after heavy rains. In some of the drainageways, the surface soil is more than 24 inches thick.

Included with this soil in mapping are small areas of Hamerly, Vallers, Fulda, and Quam soils. The moderately well drained, calcareous Hamerly soils are on low knolls. The poorly drained, calcareous Vallers soils are on the edges of depressions. The poorly drained, clayey Fulda soils are in positions on the landscape similar to those of the Flom soil. The very poorly drained Quam soils are in shallow, closed depressions. Included soils make up about 5 to 15 percent of the unit.

Permeability is moderately slow in the Flom soil. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The seasonal high water table is at a depth of 1 to 3 feet.

This soil is used mainly for cultivated crops. If drained, it is well suited to most of the crops commonly grown in the county. The wetness is the main limitation. If the soil is worked when it is too wet, severe compaction and clodding of the surface layer are likely to occur. Large open areas are subject to soil blowing. A system of conservation tillage that leaves the surface rough and keeps crop residue on the surface helps to maintain good tilth and reduces the hazard of soil blowing. Grassed waterways are needed in areas where water flows across this soil.

The land capability classification is IIw.

51—La Prairie loam. This nearly level, moderately well drained soil is on flood plains at the slightly higher levels adjacent to streams. It is occasionally flooded. Individual areas are long and narrow and range from 3 to 200 acres in size.

Typically, the surface layer is very dark gray loam about 13 inches thick. The subsurface layer also is very dark gray loam. It is about 12 inches thick. The subsoil is very dark grayish brown loam about 11 inches thick. The underlying material to a depth of about 60 inches is dark grayish brown loam. It is mottled in the lower part. In places the soil has thin strata of sand or silt.

Included with this soil in mapping are small areas of Lamoure and Terril soils. Lamoure soils are in the lower positions on the flood plains and are poorly drained. Terril soils formed in local colluvium and are on the foot slopes in the steeper areas adjacent to the flood plains. Included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the La Prairie soil. Available water capacity is high. Surface runoff is slow. Organic matter content is moderate or high. The seasonal high water table is at a depth of 3.5 to 6.0 feet.

This soil is used mainly for cultivated crops. It is well suited to most of the crops commonly grown in the county, but the occasional flooding is a hazard. Also, the seasonal wetness is a limitation. Ditching helps to straighten and deepen streams and thus reduces the hazard of flooding. Tile drains can improve drainage in low areas adjacent to the ditches. Applying a system of conservation tillage in the fall maintains a surface cover and thus helps to control soil blowing and allows faster drying in the spring.

The land capability classification is IIw.

70—Svea loam. This nearly level, moderately well drained soil is on the concave parts of side slopes and on flats on moraines. Individual areas are irregular in shape and range from 3 to 25 acres in size.

Typically, the surface layer is black loam about 8 inches thick. The subsurface layer is loam about 11 inches thick. It is black in the upper part and very dark gray in the lower part. The subsoil is olive brown and light olive brown, mottled loam about 11 inches thick. The underlying material to a depth of about 60 inches is mottled loam. It is grayish brown in the upper part, light olive brown in the next part, and grayish brown in the lower part.

Included with this soil in mapping are small areas of the poorly drained Flom, very poorly drained Quam, and moderately well drained Hamerly soils. Flom and Quam soils are in drainageways and shallow depressions. The sloping Hamerly soils are on knolls. Included soils make up about 5 to 15 percent of the unit.

Permeability is moderate in the upper part of the Svea soil and moderate or moderately slow in the lower part. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The seasonal high water table is at a depth of 4 to 6 feet.

This soil is used mainly for cultivated crops. It is well suited to most of the crops commonly grown in the county. Returning crop residue to the soil can help to maintain good tilth and soil structure.

The land capability classification is I.

86—Canisteo clay loam. This nearly level, poorly drained soil is on the edges of depressions, in drainageways, and on low flats on moraines. Individual areas are irregular in shape and range from 3 to several hundred acres in size.

Typically, the surface layer is black clay loam about 9 inches thick. The subsurface layer also is black clay

loam. It is about 14 inches thick. The subsoil is dark gray and dark grayish brown, mottled clay loam about 13 inches thick. The underlying material to a depth of about 60 inches is olive gray, mottled clay loam.

Included with this soil in mapping are small areas of Glencoe, Webster, and Crippin soils. The very poorly drained Glencoe soils are in shallow depressions. The poorly drained Webster soils are in drainageways or on flats in the slightly higher landscape positions. They are not calcareous to the surface. The somewhat poorly drained Crippin soils are on the slightly higher slopes and knolls within areas of the Canisteo soil. Also included are small areas of soils that are underlain by sandy and gravelly material. Included soils make up about 5 to 15 percent of the unit.

Permeability is moderate in the Canisteo soil. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The seasonal high water table is at a depth of 1 to 3 feet.

This soil is used mainly for cultivated crops. If drained, it is well suited to most of the crops commonly grown in the county. The wetness is the main limitation. If crop growth is poor even after an adequate drainage system has been installed, applications of potassium and phosphorus fertilizer are needed to correct the fertility imbalance caused by a high content of lime. Soybeans grown on this soil commonly are affected by chlorosis, which results from a lack of available iron. This limitation can be overcome by installing a drainage system and by growing varieties of soybeans that can tolerate excess lime. The ground water in some areas contains enough magnesium sulfate to cause disintegration of ordinary cement tile. Clay tile or alkaline-resistant tile should be used. Fall tillage permits earlier preparation of a seedbed in spring. A system of conservation tillage that leaves the surface rough and keeps crop residue on the surface can reduce the hazard of soil blowing.

The land capability classification is IIw.

94B—Terril loam, 2 to 8 percent slopes. This gently sloping and sloping, moderately well drained soil is on narrow, concave foot slopes and in drainageways on uplands. Individual areas are about 50 to 200 feet long and range from 3 to 50 acres in size.

Typically, the surface layer is black loam about 9 inches thick. The subsurface layer is loam about 26 inches thick. It is black in the upper part and very dark brown in the lower part. The subsoil is very dark grayish brown and dark yellowish brown loam about 18 inches thick. The underlying material to a depth of about 60 inches is brown, mottled loam. In some places it has thin layers of gravelly, sandy, or cobbly material. In other places the surface soil is less than 24 inches thick.

Included with this soil in mapping are small areas of the well drained Buse and Storden soils, small areas of the moderately well drained La Prairie soils, and small areas of sandy soils. Buse and Storden soils are on the upper parts of the slopes adjacent to the Terril soil. La Prairie soils are on flood plains. Also included are a few steep areas. Included soils make up about 2 to 10 percent of the unit.

Permeability is moderate in the Terril soil. Available water capacity is high. Organic matter content also is high. Surface runoff is medium.

This soil is used mainly for cultivated crops. It is well suited to most of the crops commonly grown in the county. Water erosion is the main hazard. If erosion occurs on the higher adjacent soils, the eroded soil material is likely to injure or smother plants growing on this soil. Terraces and contour strips should be on a slight grade so that water does not collect between the rows. Grassed waterways are needed in areas where runoff flows across this soil.

The land capability classification is IIe.

96A—Collinwood silty clay, 0 to 2 percent slopes. This nearly level, moderately well drained soil is on plane and slightly concave hilltops and side slopes on till plains. Individual areas are irregular in shape and range from 3 to 100 acres in size.

Typically, the surface layer is black silty clay about 8 inches thick. The subsurface layer is silty clay about 10 inches thick. It is black in the upper part and very dark gray in the lower part. The subsoil is dark grayish brown silty clay about 16 inches thick. It is mottled in the lower part. The underlying material to a depth of about 60 inches is grayish brown, mottled silty clay. In places glacial till is within 40 inches of the surface.

Included with this soil in mapping are small areas of the more sloping Collinwood soils on side slopes and small areas of the poorly drained Waldorf and Spicer soils on the lower flats and in drainageways. Included soils make up about 2 to 10 percent of the unit.

Permeability is moderately slow or slow in the Collinwood soil. Available water capacity is moderate. Organic matter content is high. Surface runoff is medium. Depth to the seasonal high water table is 2 to 5 feet.

This soil is used mainly for cultivated crops. If drained, it is well suited to most of the crops commonly grown in the county. The wetness is a limitation, especially in the spring. If worked when wet, the soil

can become compacted and cloddy. Compaction and poor tilth can be avoided by restricting fieldwork during wet periods. Fall tillage allows the soil to warm up more rapidly in the spring. Soil blowing is a hazard, however, on fall-tilled fields. A system of conservation tillage that leaves the surface rough and keeps crop residue on the surface can reduce the hazard of soil blowing. A single-row field windbreak helps to control soil blowing and conserves moisture.

The land capability classification is IIw.

96B—Collinwood silty clay, 2 to 6 percent slopes. This gently sloping, moderately well drained soil is on convex hilltops and side slopes on till plains. Individual areas are 50 to 250 feet long and range from 3 to 40 acres in size.

Typically, the surface layer is black silty clay about 8 inches thick. The subsurface layer is silty clay about 10 inches thick. It is black in the upper part and very dark gray in the lower part. The subsoil is dark grayish brown silty clay about 6 inches thick. It is mottled in the lower part. The underlying material to a depth of about 60 inches is grayish brown, mottled silty clay. In places glacial till is within 40 inches of the surface.

Included with this soil in mapping are small areas of the well drained Clarion soils on side slopes and small areas of the poorly drained Waldorf and Spicer soils on flats and in drainageways. Included soils make up about 5 to 15 percent of the unit.

Permeability is moderately slow or slow in the Collinwood soil. Available water capacity is moderate. Organic matter content is high. Surface runoff is medium. The seasonal high water table is at a depth of 2 to 5 feet.

This soil is used mainly for cultivated crops. It is well suited to most of the crops commonly grown in the county. Water erosion is the main hazard. Soil blowing also is a hazard. A system of conservation tillage that leaves the surface rough and keeps crop residue on the surface can reduce the hazards of soil blowing and water erosion. A single-row field windbreak can help to control soil blowing and conserves moisture.

The land capability classification is IIe.

102B—Clarion loam, 2 to 4 percent slopes. This gently undulating, well drained soil is on convex hilltops and side slopes on till plains and moraines. Individual areas are 75 to 200 feet long and range from 3 to 150 acres in size.

Typically, the surface layer is black loam about 8 inches thick. The subsurface layer is very dark grayish brown loam about 4 inches thick. The subsoil is brown loam about 11 inches thick. The underlying material to a depth of about 60 inches is yellowish brown loam. It is mottled in the lower part. In places sandy and silty sediments are within 40 inches of the surface.

Included with this soil in mapping are small areas of the more sloping, eroded Clarion soils, the well drained, calcareous Storden soils on shoulder slopes, the poorly drained Canisteo and Webster soils on toe slopes and in drainageways, and the moderately well drained Nicollet soils on hilltops and concave side slopes. Included soils make up about 5 to 10 percent of the unit.

Permeability is moderate in the Clarion soil. Available water capacity is high. Organic matter content is moderate or high. Surface runoff is medium.

This soil is used mainly for cultivated crops. It is well suited to most of the crops commonly grown in the county. Water erosion is the main hazard. Many areas are suitable for terracing or farming on the contour. These measures can help to control erosion and conserve moisture. A system of conservation tillage that leaves the surface rough and keeps crop residue on the surface also helps to prevent excessive soil loss. In some areas tilth is poor because of a loss of organic matter through erosion. Including green manure or sod crops in the cropping sequence improves soil structure and tilth.

The land capability classification is IIe.

102B2—Clarion loam, 3 to 6 percent slopes, eroded. This undulating, well drained soil is on convex side slopes on till plains and moraines. Erosion has exposed the subsoil in places. Individual areas are about 75 to 175 feet long and range from 3 to 100 acres in size.

Typically, the surface layer is very dark grayish brown loam about 8 inches thick. The subsoil is brown loam about 11 inches thick. The underlying material to a depth of about 60 inches is yellowish brown loam. In some areas the soil does not have free lime. In other areas the surface layer is lighter colored.

Included with this soil in mapping are small areas of the less sloping Clarion soils, the well drained, calcareous Storden soils on the steeper shoulder slopes, the poorly drained Canisteo and Webster soils on toe slopes and in drainageways, and the moderately well drained Nicollet soils on concave side slopes and hilltops. Also included are small areas of silty or sandy soils. Included soils make up about 5 to 15 percent of the unit.

Permeability is moderate in the Clarion soil. Available water capacity is high. Organic matter content is moderate. Surface runoff is medium.

This soil is used mainly for cultivated crops. It is well suited to most of the crops commonly grown in the county. Water erosion is the main hazard. Many areas are suitable for terracing or farming on the contour. These measures can help to control erosion and conserve moisture. A system of conservation tillage that leaves the surface rough and keeps crop residue on the surface also helps to prevent excessive soil loss. In some areas tilth is poor because of a loss of organic matter through erosion. Including green manure or sod crops in the cropping sequence improves soil structure and tilth.

The land capability classification is IIe.

113—Webster clay loam. This nearly level, poorly drained soil is on low flats and in drainageways on till plains and moraines. Individual areas are irregular in shape and range from 3 to more than 200 acres in size.

Typically, the surface layer is black clay loam about 9 inches thick. The subsurface layer also is black clay loam. It is about 11 inches thick. The subsoil is very dark gray and dark grayish brown, mottled clay loam about 10 inches thick. The underlying material to a depth of about 60 inches is olive gray and olive, mottled clay loam and loam. In many drainageways the surface soil is more than 24 inches thick.

Included with this soil in mapping are small areas of Glencoe, Lura, Canisteo, Terril, Waldorf, and Nicollet soils. The very poorly drained Glencoe and Lura soils are in depressions. The calcareous Canisteo soils are on the rims of depressions. The moderately well drained Terril soils are on foot slopes. The clayey Waldorf soils are in positions on the landscape similar to those of the Webster soil, and the moderately well drained Nicollet soils are in slightly higher positions. Included soils make up about 3 to 10 percent of the unit.

Permeability is moderate in the Webster soil. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The seasonal high water table is at a depth of 1 to 2 feet.

This soil is used mainly for cultivated crops. If drained, it is well suited to most of the crops commonly grown in the county. The wetness is the main limitation. The soil dries out and warms up slowly in spring. If the soil is worked when it is very wet, severe compaction and clodding of the surface layer are likely to occur. Large open areas are subject to soil blowing. A system of conservation tillage that leaves the surface rough and keeps crop residue on the surface reduces the hazard of soil blowing and helps to maintain tilth. Fall tillage permits earlier preparation of a seedbed in spring.

The land capability classification is IIw.

114—Glencoe silty clay loam. This nearly level, very poorly drained soil is in depressions and drainageways on moraines. It is subject to ponding. Individual areas are irregular in shape and range from 3 to 100 acres in size.

Typically, the surface layer is black silty clay loam about 9 inches thick. The subsurface layer is silty clay loam about 24 inches thick. It is black in the upper part and very dark gray and mottled in the lower part. The subsoil is olive gray, mottled clay loam about 13 inches thick. The underlying material to a depth of about 60 inches is olive, mottled clay loam. Near the center of some depressions, the subsoil is clayey. In a few depressional areas, a thin layer of muck is at the surface. In places free lime is in the surface layer.

Included with this soil in mapping are small areas of Canisteo, Lura, and Rolfe soils. The poorly drained, calcareous Canisteo soils are along the edges of the depressions and on low knolls that are slightly higher than the bottom of the depressions. The very poorly drained, clayey Lura and Rolfe soils occur as small areas in some of the depressions. Included soils make up about 2 to 15 percent of the unit.

Permeability is moderately slow or slow in the Glencoe soil. Available water capacity is high. Organic matter content is high or very high. Surface runoff is slow to ponded. The seasonal high water table is 1 foot above to 1 foot below the surface.

This soil is used mainly for cultivated crops. If drained, it is fairly well suited to most of the crops commonly grown in the county. The wetness is the main limitation. Open ditches can drain surface water and in places provide outlets for tile drains. Soil blowing is a hazard. It can be controlled, however, by applying a system of conservation tillage that leaves the fields rough and keeps some crop residue on the surface. Measures that minimize compaction and maintain good tilth are needed. Restricting fieldwork during wet periods, returning crop residue to the soil, and growing sod crops help to maintain good tilth. Fall tillage permits earlier preparation of a seedbed in spring.

The land capability classification is IIIw.

118—Crippin loam. This nearly level, somewhat poorly drained soil is on low, slightly convex knolls and peninsulas in low areas on till plains and moraines. Individual areas are irregular in shape and range from 3 to 40 acres in size.

Typically, the surface layer is black loam about 11 inches thick. The subsurface layer also is black loam. It is about 6 inches thick. The subsoil is loam about 18 inches thick. The upper part is dark grayish brown, the next part is dark grayish brown and mottled, and the lower part is olive brown and mottled. The underlying material to a depth of about 60 inches is olive gray, mottled loam.

Included with this soil in mapping are small areas of Canisteo and Nicollet soils. The poorly drained Canisteo soils are in concave areas. The noncalcareous, moderately well drained Nicollet soils are on concave side slopes and on flats. Included soils make up about 5 to 15 percent of the unit.

Permeability is moderate in the Crippin soil. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The seasonal high water table is at a depth of 2 to 4 feet.

In most areas this soil is used as cropland. It is well suited to most of the crops commonly grown in the county. In places a high content of lime may cause a fertility imbalance. This limitation can be overcome by applying potassium and phosphorus fertilizer.

The land capability classification is I.

127A—Sverdrup sandy loam, 0 to 2 percent slopes. This nearly level, well drained soil is on convex hilltops and in swales on outwash plains, stream terraces, and moraines. Individual areas are irregular in shape and range from 4 to 50 acres in size.

Typically, the surface layer is very dark gray sandy loam about 12 inches thick. The subsoil is about 16 inches thick. It is dark brown sandy loam in the upper part and dark yellowish brown loamy sand in the lower part. The underlying material to a depth of about 60 inches is brown and light yellowish brown sand. In places the underlying material is gravelly. In some small areas the surface layer and subsoil are sandy.

Permeability is moderately rapid. Available water capacity is low. Organic matter content is moderate. Surface runoff is slow.

This soil is used mainly for cultivated crops. It is fairly well suited to most of the crops commonly grown in the county. Droughtiness is the major limitation, and soil blowing is a hazard (fig. 7). Applying a system of conservation tillage and returning all crop residue to the soil can help to prevent excessive soil loss and conserve moisture. Spring tillage also helps to prevent excessive soil loss. Leaving crop residue on the surface during winter helps to trap snow and conserves moisture. A single-row field windbreak helps to control soil blowing and conserves moisture.

The land capability classification is IIIs.

127B—Sverdrup sandy loam, 2 to 6 percent slopes. This gently undulating, well drained soil is on knolls and side slopes on moraines, stream terraces, and outwash plains. Individual areas are irregular in shape and range from 3 to 90 acres in size.

Typically, the surface layer is very dark gray sandy loam about 8 inches thick. The subsoil is about 20 inches thick. It is dark brown sandy loam in the upper part and dark brown loamy sand in the lower part. The underlying material to a depth of about 60 inches is brown and light yellowish brown sand. In some places the underlying material is gravelly. In other places the subsoil and underlying material contain more silt and fine sand.

Permeability is moderately rapid. Available water capacity is low. Organic matter is moderate. Surface runoff is slow.

This soil is used mainly for cultivated crops. It is fairly well suited to most of the crops commonly grown in the county. Water erosion is the main hazard, and droughtiness is a limitation. Leaving crop residue on the surface during winter helps to trap snow, conserves moisture, and helps to control soil blowing. Conservation tillage practices, such as chisel plowing, reduce the risks of soil blowing and moisture loss. A single-row field windbreak reduces the risk of soil blowing and the loss of moisture through evaporation and transpiration. Wind stripcropping, or growing close-growing crops and row crops in alternating narrow bands, also reduces soil and moisture loss.

The land capability classification is IIIe.

127C—Sverdrup sandy loam, 6 to 12 percent slopes. This well drained soil is on ridges, knolls, and side slopes on moraines and on moderately sloping stream terraces and outwash plains. Individual areas are irregular in shape and range from 3 to 40 acres in size.

Typically, the surface layer is very dark gray sandy loam about 8 inches thick. The subsoil is about 20 inches thick. It is dark brown sandy loam in the upper part and dark yellowish brown loamy sand in the lower part. The underlying material to a depth of about 60 inches is brown and light yellowish brown sand. In some places the underlying material is gravelly. In other places the subsoil and underlying material contain more silt and very fine sand.

Permeability is moderately rapid. Available water

Figure 7.—An area of Sverdrup sandy loam, 0 to 2 percent slopes. Soil blowing is a serious problem on this soil.

capacity is low. Organic matter content is moderate. Surface runoff is medium.

This soil is used mainly for cultivated crops. It is poorly suited to most of the crops commonly grown in the county. Water erosion is the main hazard. Soil blowing also is a hazard. A system of conservation tillage that keeps crop residue on the surface helps to prevent excessive soil loss and conserves moisture. Spring tillage also helps to prevent excessive soil loss. Leaving crop residue on the surface during winter helps to trap snow and conserves moisture. A single-row field windbreak helps to control soil blowing and conserves moisture.

The land capability classification is IVe.

130—Nicollet loam. This nearly level, moderately well drained soil is on plane and slightly concave side slopes and hilltops on till plains and moraines.

Individual areas are irregular in shape and range from 5 to 50 acres in size.

Typically, the surface layer is black loam about 9 inches thick. The subsurface layer is very dark brown loam about 7 inches thick. The subsoil is mottled loam about 12 inches thick. It is dark brown in the upper part and dark grayish brown in the lower part. The underlying material to a depth of about 60 inches is light olive brown, mottled loam. In places carbonates are within 40 inches of the surface.

Included with this soil in mapping are small areas of the well drained Clarion soils on side slopes, the somewhat poorly drained Crippin soils on slightly convex knolls, and the poorly drained Webster soils in drainageways and on low flats. Included soils make up about 5 to 15 percent of the unit.

Permeability is moderate in the Nicollet soil. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The seasonal high water table is at a depth of 2.5 to 5.0 feet.

This soil is used mainly for cultivated crops. It is well suited to most of the crops commonly grown in the county. Returning crop residue to the soil and restricting fieldwork during wet periods help to prevent compaction and improve tilth.

The land capability classification is I.

140—Spicer silty clay loam. This nearly level, poorly drained soil is along the edges of depressions and on low flats on till plains and moraines. Individual areas are irregular in shape and range from 3 to 100 acres in size.

Typically, the surface layer is black silty clay loam about 9 inches thick. The subsurface layer is very dark gray silty clay loam about 5 inches thick. The subsoil is about 17 inches thick. The upper part is dark grayish brown, mottled silty clay loam, and the lower part is olive gray, mottled silt loam. The underlying material to a depth of about 60 inches is olive gray and gray, mottled silt loam.

Included with this soil in mapping are small areas of the moderately well drained Overly soils and the poorly drained Waldorf soils. Overly soils are on low rises. Waldorf soils are on broad flats and in swales. They are not calcareous near the surface. Also included are small areas of soils that contain appreciable amounts of gypsum and that are underlain by glacial till or coarse textured sediments. Included soils make up about 5 to 15 percent of the unit.

Permeability is moderate in the Spicer soil. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The seasonal high water table is at a depth of 1 to 3 feet.

This soil is used mainly for cultivated crops. If drained, it is well suited to most of the crops commonly grown in the county. The wetness is the main limitation. If crop growth is poor even after a drainage system has been installed, applications of potassium and phosphorus fertilizer are needed to correct the fertility imbalance caused by a high content of lime. Soybeans grown on this soil commonly are affected by chlorosis, which results from a lack of available iron. This limitation can be overcome by installing a drainage system and by growing varieties of soybeans that can tolerate excess lime. The ground water in some areas contains enough magnesium sulfate to cause disintegration of ordinary cement tile. Clay tile or alkaline-resistant tile should be used. A system of conservation tillage that leaves the surface rough and keeps crop residue on the surface can reduce the hazard of soil blowing.

The land capability classification is IIw.

141A—Egeland sandy loam, 0 to 2 percent slopes. This nearly level, well drained soil is on low flats and in drainageways on moraines, stream terraces, and outwash plains. Individual areas are irregular in shape and range from 3 to 60 acres in size.

Typically, the surface layer is black sandy loam about 9 inches thick. The subsoil is about 27 inches thick. It is dark grayish brown sandy loam in the upper part, dark brown sandy loam in the next part, and dark yellowish brown loamy sand in the lower part. The upper part of the underlying material is yellowish brown loamy sand. The lower part to a depth of about 60 inches is yellowish brown sand. In some areas loamy glacial till or silty sediments are at a depth of 3 to 6 feet.

Included with this soil in mapping are small areas of the steeper Egeland soils, the somewhat excessively drained Arvilla soils, and the well drained Poinsett soils. Arvilla soils have more gravel in the underlying material than the Egeland soil. Also, they are higher on the landscape. Poinsett soils are on hilltops and side slopes. They have a higher content of clay and silt than the Egeland soil. Included soils make up about 3 to 10 percent of the unit.

Permeability is moderately rapid in the Egeland soil. Available water capacity is moderate. Organic matter content is moderately low or moderate. Surface runoff is slow.

This soil is used mainly for cultivated crops. It is fairly well suited to most of the crops commonly grown in the

county. Droughtiness is the major limitation, and soil blowing is a hazard. Leaving crop residue on the surface during the winter helps to trap snow and provides moisture for the next crop. A single-row field windbreak helps to control soil blowing and conserves moisture. Grassed waterways help to prevent the formation of gullies, which can cut into the sandy underlying material.

The land capability classification is IIIs.

141B—Egeland sandy loam, 2 to 6 percent slopes. This undulating, well drained soil is on ridges and convex side slopes on moraines, stream terraces, and outwash plains. Individual areas are 50 to 200 feet long and range from 3 to 120 acres in size.

Typically, the surface layer is very dark gray sandy loam about 9 inches thick. The subsoil is about 24 inches thick. It is dark yellowish brown. It is sandy loam in the upper part and loamy sand in the lower part. The underlying material to a depth of about 60 inches is yellowish brown loamy fine sand. In some areas loamy glacial till or silty sediments are at a depth of more than 3 feet.

Included with this soil in mapping are a few areas of the nearly level Egeland soils in narrow swales and drainageways. Also included are a few areas of the somewhat excessively drained Arvilla and well drained Poinsett soils in landscape positions similar to those of the Egeland soil. Arvilla soils have more gravel in the underlying material than the Egeland soil. Poinsett soils have a higher content of clay and silt than the Egeland soil. Included soils make up about 5 to 15 percent of the unit.

Permeability is moderately rapid in the Egeland soil. Available water capacity is moderate. Organic matter content is moderately low or moderate. Surface runoff is slow or medium.

This soil is used mainly for cultivated crops. It is fairly well suited to most of the crops commonly grown in the county. Water erosion is the main hazard, and droughtiness is a limitation. Leaving crop residue on the surface during the winter helps to trap snow and provides moisture for the next crop. A single-row field windbreak helps to control soil blowing and conserves moisture. Grassed waterways help to prevent the formation of gullies, which can cut into the sandy underlying material.

The land capability classification is IIIe.

149B—Everly clay loam, 2 to 4 percent slopes. This gently undulating, well drained soil is on convex hilltops and side slopes on moraines. Individual areas are about 125 to 200 feet long and range from 3 to 200 acres in size.

Typically, the surface layer is black clay loam about 9 inches thick. The next layer is very dark gray and dark brown clay loam about 4 inches thick. The subsoil is about 18 inches thick. The upper part is dark yellowish brown clay loam, and the lower part is brown loam. The underlying material to a depth of about 60 inches is yellowish brown, mottled loam.

Included with this soil in mapping are small areas of the more sloping Everly soils, the poorly drained Letri soils, and the moderately well drained Wilmonton soils. Letri soils are in drainageways. Wilmonton soils are in swales and on the concave parts of side slopes. Included soils make up about 5 to 15 percent of the unit.

Permeability is moderate or moderately slow in the Everly soil. Available water capacity is high. Organic matter content is moderate. Surface runoff is medium.

This soil is used mainly for cultivated crops. It is well suited to most of the crops commonly grown in the county. Water erosion is the main hazard. A system of conservation tillage that leaves the surface rough helps to prevent excessive soil loss in broad open areas. Grassed waterways are needed in areas where runoff flows across this soil.

The land capability classification is IIe.

149B2—Everly clay loam, 3 to 6 percent slopes, eroded. This undulating, well drained soil is on convex side slopes on moraines. Erosion has exposed the subsoil in places. Individual areas are about 100 to 200 feet long and range from 3 to 80 acres in size.

Typically, the surface layer is very dark grayish brown clay loam about 8 inches thick. The subsoil is about 18 inches thick. The upper part is dark yellowish brown clay loam, and the lower part is brown loam. The underlying material to a depth of about 60 inches is yellowish brown, mottled loam. In some places the soil does not have free lime. In other places the surface layer is lighter colored.

Included with this soil in mapping are small areas of the less sloping or more sloping Everly soils, the well drained Storden soils, and the moderately well drained Wilmonton soils. The calcareous Storden soils are on the steepest, most exposed convex parts of hillsides. Wilmonton soils are in swales and in other concave areas. Included soils make up about 5 to 15 percent of the unit.

Permeability is moderate or moderately slow in the Everly soil. Available water capacity is high. Organic matter content is low. Surface runoff is medium.

This soil is used mainly for cultivated crops. It is well suited to most of the crops commonly grown in the county. Water erosion is the main hazard, but it can be controlled by contour farming or terraces. A system of conservation tillage that leaves crop residue on the surface also helps to prevent excessive soil loss. In some areas tilth is poor because of a loss of organic matter through erosion. Including green manure or sod crops in the cropping sequence improves soil structure and tilth. Grassed waterways are needed in areas where runoff crosses this soil.

The land capability classification is IIe.

149C2—Everly clay loam, 6 to 12 percent slopes, eroded. This sloping, well drained soil is on convex side slopes and ridges on moraines. Erosion has exposed the subsoil in places. Individual areas are 150 to 200 feet long and range from 3 to 30 acres in size.

Typically, the surface layer is very dark grayish brown clay loam about 8 inches thick. The subsoil is about 18 inches thick. It is dark yellowish brown clay loam in the upper part and brown loam in the lower part. The underlying material to a depth of about 60 inches is yellowish brown, mottled loam. In some areas the soil does not have free lime. In other areas the surface layer is lighter colored.

Included with this soil in mapping are small areas of the moderately well drained Terril soils and the well drained, calcareous Storden soils and small areas of sand and gravel. Terril soils are in shallow drainageways and on foot slopes. Storden soils are on the steepest, most exposed parts of the side slopes. Included soils make up about 5 to 15 percent of the unit.

Permeability is moderate or moderately slow in the Everly soil. Available water capacity is high. Organic matter content is very low. Surface runoff is rapid.

This soil is used mainly for cultivated crops. It is fairly well suited to most of the crops commonly grown in the county. Water erosion is the main hazard, but it can be controlled in many areas by terracing or by farming on the contour. In areas where slopes are too irregular for terraces or contour farming, other management practices are needed to control runoff and erosion. These practices include conservation tillage, heavy applications of manure, and a crop rotation that includes small grain and hay. In some areas tilth is poor because of a loss of organic matter through erosion. Including green manure or sod crops in the cropping sequence improves soil structure and tilth. Grassed waterways are needed in areas where runoff flows across this soil.

The land capability classification is IIIe.

184—Hamerly loam. This nearly level, moderately well drained soil is on knolls and peninsulas in low areas on moraines. Individual areas are irregular in shape and range from 3 to 100 acres in size.

Typically, the surface layer is black loam about 8 inches thick. The subsurface layer is very dark gray loam about 5 inches thick. The next layer is dark brown and olive brown loam about 7 inches thick. The subsoil is light olive brown loam about 11 inches thick. The underlying material to a depth of about 60 inches is light olive brown, mottled loam. In some places the surface layer has been leached of free lime. In other places stones are on the surface.

Included with this soil in mapping are small areas of the poorly drained Vallers soils in the slightly lower positions on the landscape and small areas of the very poorly drained Quam soils in depressions. Also included are small areas of the sandy Sverdrup and Arvilla soils in positions on the landscape similar to those of the Hamerly soil. Included soils make up about 5 to 15 percent of the unit.

Permeability is moderate in the Hamerly soil. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The seasonal high water table is at a depth of 2.5 to 4.0 feet.

This soil is used mainly for cultivated crops. It is well suited to most of the crops commonly grown in the county. In places a high content of lime causes a fertility imbalance, but applications of potassium and phosphorus fertilizer help to overcome this limitation. Soybean varieties that are tolerant of the high content of lime should be selected for planting. The hazard of soil blowing is slight. A system of conservation tillage that leaves crop residue on the surface reduces the risk of soil blowing on fall-tilled fields during the winter and spring. If a drainage system is installed in the wetter adjoining soils, managing this soil is easier.

The land capability classification is IIs.

210—Fulda silty clay. This nearly level, poorly drained soil is on low flats and in drainageways on moraines. It is subject to rare flooding. Individual areas are irregular in shape and range from 3 to 40 acres in size.

Typically, the surface layer is black silty clay about 9 inches thick. The subsurface layer also is black silty clay. It is about 7 inches thick. The subsoil is mottled silty clay about 25 inches thick. It is very dark gray in the upper part, dark grayish brown in the next part, and olive gray in the lower part. The underlying material to a

depth of about 60 inches is olive gray, mottled clay loam. In drainageways and near the base of slopes, the surface soil is more than 24 inches thick. In places gypsum crystals are in the parent material.

Included with this soil in mapping are small areas of calcareous soils. Also included are small areas of the very poorly drained, clayey Lura soils in depressions and small areas of the moderately well drained Sinai soils on the slightly higher parts of the landscape. Included soils make up about 2 to 8 percent of the unit.

Permeability is moderately slow or slow in the Fulda soil. Available water capacity is high. Organic matter is high or very high. Surface runoff is slow. The seasonal high water table is at a depth of 1 to 3 feet.

This soil is used mainly for cultivated crops. If drained, it is well suited to most of the crops commonly grown in the county. The wetness is the main limitation. Restricting fieldwork during wet periods and returning crop residue to the soil minimize compaction and improve tilth.

The land capability classification is IIw.

211—Lura silty clay. This nearly level, very poorly drained soil is in depressions on till plains or moraines. It is subject to ponding and rare flooding. Individual areas are irregular in shape and range from 10 to 60 acres in size.

Typically, the surface layer is black silty clay about 10 inches thick. The subsurface layer is silty clay about 31 inches thick. The upper part is black, and the lower part is very dark gray and mottled. The subsoil is olive gray, mottled silty clay about 9 inches thick. The underlying material to a depth of about 60 inches also is olive gray, mottled silty clay.

Included with this soil in mapping are small areas of the poorly drained Spicer and Waldorf soils. These soils are on the edges of depressions and on broad, low flats. They make up about 2 to 10 percent of the unit.

Permeability is slow in the Lura soil. Available water capacity is moderate. Organic matter content is high. Surface runoff is slow to ponded. The seasonal high water table is 1 foot above to 1 foot below the surface.

This soil is used mainly for cultivated crops. If drained, it is fairly well suited to most of the crops commonly grown in the county. The wetness is the main limitation. Compaction and poor tilth result if the soil is worked when it is very wet. Restricting fieldwork during wet periods helps to prevent compaction and deterioration of tilth. Applying a system of conservation tillage in the fall allows the soil to warm up sooner in the spring and helps maintain a rough surface, which reduces the hazard of soil blowing.

The land capability classification is IIIw.

212—Sinai silty clay. This nearly level, moderately well drained soil is on plane and slightly concave hilltops and side slopes on moraines. Individual areas are irregular in shape and range from 3 to 150 acres in size.

Typically, the surface layer is black silty clay about 17 inches thick. The subsurface layer is very dark gray silty clay about 6 inches thick. The subsoil is dark grayish brown silty clay about 13 inches thick. It is mottled in the lower part. The underlying material to a depth of about 60 inches is grayish brown, mottled silty clay loam. In some places the surface layer is calcareous. In other places glacial till is within 40 inches of the surface.

Included with this soil in mapping are small areas of Fulda and Poinsett soils. The poorly drained Fulda soils are in the lower, more concave areas. The well drained Poinsett soils are in the higher positions on the landscape. Included soils make up about 2 to 15 percent of the unit.

Permeability is slow in the Sinai soil. Available water capacity is moderate. Organic matter content is high. Surface runoff is slow.

This soil is used mainly for cultivated crops. It is well suited to most of the crops commonly grown in the county. Working this clayey soil is somewhat difficult. If the soil is worked when it is very wet, a dense layer develops below the surface layer and hard clods that are difficult to break also may form in the surface layer. Alfalfa, sweet clover, and other deep-rooted legumes open channels in the clayey subsoil and help to maintain adequate drainage. The hazard of soil blowing is slight or moderate. If the soil is tilled in the fall, this hazard can be reduced by a system of conservation tillage that leaves the surface rough and keeps crop residue on the surface. A single-row field windbreak also helps to control soil blowing. Grassed waterways help to control runoff that flows across this soil.

The land capability classification is IIs.

219—Rolfe silt loam. This nearly level, very poorly drained soil is in closed depressions on till plains. It is subject to ponding. Individual areas are irregular in shape and range from 3 to 25 acres in size.

Typically, the surface layer is black silt loam about 10 inches thick. The subsurface layer is dark gray silt loam about 10 inches thick. The subsoil is about 25 inches thick. It is very dark gray, mottled silty clay in the upper part; dark grayish brown, mottled silty clay loam in the next part; and olive gray, mottled clay loam in the lower

part. The underlying material to a depth of about 60 inches is olive gray and olive, mottled clay loam.

Included with this soil in mapping are small areas of Glencoe and Webster soils. The very poorly drained Glencoe soils are in depressions. The poorly drained Webster soils are on the sides of depressions and drainageways. Both of the included soils are less clayey than the Rolfe soil. They make up about 5 to 15 percent of the unit.

Permeability is slow in the Rolfe soil. Available water capacity is high. Organic matter content is moderate or high. Surface runoff is very slow or ponded. The seasonal high water table is 1 foot above to 1 foot below the surface.

This soil is used mainly for cultivated crops. If drained, it is fairly well suited to most of the crops commonly grown in the county. The wetness is the main limitation. Management that minimizes compaction and maintains good tilth is needed. Tile drains are needed to improve subsurface drainage, but the slowly permeable subsoil reduces the effectiveness of the tile. Open ditches drain away surface water and in places provide outlets for tile drains. A system of conservation tillage that leaves the fields rough and keeps some crop residue on the surface reduces the risk of soil blowing. If the soil is worked when very wet, hard clods that are difficult to break can form. An occasional sod or green manure crop helps to maintain good tilth in the surface layer.

The land capability classification is IIIw.

229—Waldorf silty clay. This nearly level, poorly drained soil is in drainageways and on low flats on till plains. Individual areas are irregular in shape and range from 3 to more than 200 acres in size.

Typically, the surface layer is black silty clay about 8 inches thick. The subsurface layer also is black silty clay. It is about 13 inches thick. It is mottled in the lower part. The subsoil is olive gray, mottled silty clay about 21 inches thick. The underlying material to a depth of about 60 inches is light olive gray, mottled silty clay. In places glacial till is within 40 inches of the surface.

Included with this soil in mapping are small areas of the poorly drained, calcareous Spicer soils, the very poorly drained Lura soils, and the moderately well drained Collinwood soils. Spicer soils are on the edges of depressions and on slight rises on broad flats. Lura soils are clayey. They are in depressions. Collinwood soils are on side slopes and knolls. Included soils make up about 5 to 15 percent of the unit.

Permeability is moderately slow or moderate in the Waldorf soil. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The seasonal high water table is within a depth of 3 feet (fig. 8).

This soil is used mainly for cultivated crops. If drained, it is well suited to most of the crops commonly grown in the county. The wetness is the main limitation. Restricting fieldwork during wet periods minimizes compaction and clodding and thus helps to maintain good soil structure and tilth. Fall tillage allows the soil to warm up sooner in the spring. A system of conservation tillage that leaves crop residue on the surface can reduce the hazard of soil blowing. A single-row field windbreak also helps to control soil blowing.

The land capability classification is IIw.

236—Vallers clay loam. This nearly level, poorly drained soil is on the edges of depressions, in drainageways, and on low flats on moraines. Individual areas are irregular in shape and range from 3 to 100 acres in size.

Typically, the surface layer is black clay loam about 8 inches thick. The subsurface layer also is black clay loam. It is about 7 inches thick. The next layer is very dark gray, mottled clay loam about 8 inches thick. The underlying material to a depth of about 60 inches is olive gray and grayish brown, mottled loam. In some places the soil has fragments of snail shells. In other places the surface soil and subsoil have fewer stones and are more silty than the underlying material. Some areas are flooded briefly during snowmelt in spring or after heavy rains.

Included with this soil in mapping are small areas of Hamerly, Flom, and Quam soils. The moderately well drained, calcareous Hamerly soils are in the slightly higher areas and on low knolls. The poorly drained, noncalcareous Flom soils are in drainageways and on the slightly higher parts on the landscape. The very poorly drained Quam soils are in depressions. Also included are some narrow sandy beach areas adjacent to large water areas and beaches of drained lakebeds. Included soils make up about 3 to 15 percent of the unit.

Permeability is moderately slow in the Vallers soil. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The seasonal high water table is at a depth of 1.0 to 2.5 feet.

This soil is used mainly for cultivated crops. If drained, it is well suited to most of the crops commonly grown in the county. The wetness is the main limitation. If crop growth is poor even after an adequate drainage system has been installed, applications of potassium

Figure 8.—The seasonal high water table in an area of Waldorf silty clay.

and phosphorus fertilizer may be needed to correct the fertility imbalance caused by a high content of lime. Soybeans generally are affected by chlorosis, which results from a lack of available iron. This limitation can be overcome by installing a drainage system and by growing varieties of soybeans that can tolerate excess lime. The ground water in some areas contains enough magnesium sulfate to cause disintegration of ordinary cement tile. A system of conservation tillage that leaves the surface rough and keeps crop residue on the surface can reduce the hazard of soil blowing on broad flats. Fall tillage permits earlier preparation of a seedbed in spring.

The land capability classification is IIw.

241—Letri clay loam. This nearly level, poorly drained soil is on low flats and in drainageways on moraines. Individual areas are irregular in shape and

range from 3 to several hundred acres in size.

Typically, the surface layer is black clay loam about 9 inches thick. The subsurface layer also is black clay loam. It is about 11 inches thick. The subsoil is mottled clay loam about 14 inches thick. The upper part is dark grayish brown, and the lower part is olive gray. The underlying material to a depth of about 60 inches is light brownish gray, mottled loam. Some areas are flooded during snowmelt in spring and after heavy rains.

Included with this soil in mapping are small areas of Glencoe, Jeffers, and Wilmonton soils. The very poorly drained Glencoe soils are in slight depressions. The calcareous Jeffers soils are on the edges of depressions. The moderately well drained Wilmonton soils are on the slightly higher parts of the landscape. Included soils make up about 3 to 10 percent of the unit.

Permeability is moderately slow in the Letri soil. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The seasonal high water table is at a depth of 0.5 foot to 2.0 feet.

This soil is used mainly for cultivated crops. If drained, it is well suited to most of the crops commonly grown in the county. The wetness is the main limitation. Severe compaction and clodding of the surface layer are likely to occur if the soil is worked when it is very wet. Large open areas are subject to soil blowing. A system of conservation tillage that leaves the surface rough and keeps crop residue on the surface can help to maintain good tilth and reduces the hazard of soil blowing. Grassed waterways are needed in areas where runoff flows across this soil.

The land capability classification is IIw.

246—Marysland loam. This nearly level, poorly drained soil is on low flats, in meltwater channels, and in overflow channels on outwash plains. It is subject to rare flooding. Individual areas are irregular in shape and range from 3 to 200 acres in size.

Typically, the surface layer is black loam about 9 inches thick. The subsurface layer is very dark gray loam about 8 inches thick. The upper part of the underlying material is grayish brown, mottled loam. The next part is olive gray, mottled loam. The lower part to a depth of about 60 inches is grayish brown, mottled gravelly coarse sand. In some areas the surface soil is 24 to 36 inches thick. In other areas the surface layer and subsoil are leached of free lime. In some places the underlying sand is 40 to 60 inches below the surface. In other places the underlying sand is only a few feet thick and is underlain by glacial till or silty alluvium.

Included with this soil in mapping are small areas of Vallers and Fordville soils. Vallers soils do not have sandy underlying material. The well drained Fordville soils are in the slightly higher positions on the landscape. They have a surface layer that is leached free of lime. Included soils make up about 2 to 10 percent of the unit.

Permeability is moderate in the upper part of the Marysland soil and rapid or very rapid in the lower part. Available water capacity is moderate. Organic matter content is high. Surface runoff is slow. The seasonal high water table is at a depth of 1.0 to 2.5 feet.

This soil is used mainly for cultivated crops. If drained, it is well suited to most of the crops commonly grown in the county. The wetness is the main limitation. The surface layer has a high content of lime, which causes a fertility imbalance. If crop growth is poor even after an adequate drainage system has been installed, applications of potassium and phosphorus fertilizer are needed. Soybeans are adversely affected by chlorosis, which results from a lack of available iron. This limitation can be overcome by installing a drainage system and by growing varieties of soybeans that can tolerate excess lime. Fall tillage permits earlier preparation of a seedbed in spring.

The land capability classification is IIw.

276—Oldham silty clay loam. This nearly level, very poorly drained soil is in drained basins of shallow lakes and ponds on uplands. It is subject to ponding. Individual areas are irregular in shape and range from 3 to 75 acres in size.

Typically, the surface layer is black silty clay loam about 16 inches thick. The subsurface layer also is black silty clay loam. It is about 13 inches thick. The subsoil is about 17 inches thick. It is very dark gray, mottled silty clay loam in the upper part and dark gray and olive gray, mottled clay loam in the lower part. The underlying material to a depth of about 60 inches is gray, mottled clay loam. In some areas the soil has layers of silty clay, silt loam, or loam. In other areas the dark surface soil is less than 24 inches thick. In a few places the surface layer and subsoil are not calcareous.

Included with this soil in mapping are small areas of the poorly drained Marysland, Spicer, and Vallers soils on the narrow rims around the depressions and in beach areas adjacent to the lakebeds. These soils make up about 5 to 15 percent of the unit.

Permeability is moderately slow or slow in the Oldham soil. Available water capacity is high. Organic matter content also is high. Surface runoff is slow to ponded. The seasonal high water table is 2 feet above to 1 foot below the surface.

This soil is used mainly for cultivated crops. If drained, it is fairly well suited to most of the crops commonly grown in the county. The wetness is the main limitation. Excess lime in the surface layer causes a fertility imbalance. If crop growth is poor even after an adequate drainage system has been installed, applications of potassium and phosphorus fertilizer are needed to correct the fertility imbalance. In some areas the ground water contains enough magnesium sulfate to cause disintegration of ordinary cement tile. Clay tile or alkali-resistant tile should be used. Crops are subject to early frost. As a result, a variety of corn that matures early is desirable. In places soil blowing is a hazard. It can be controlled by a system of conservation tillage that leaves the fields rough and keeps residue on the surface.

The land capability classification is IIIw.

284B—Poinsett silty clay loam, 2 to 4 percent slopes. This very gently sloping, well drained soil is on slightly convex hilltops and side slopes on moraines. Individual areas are about 125 to 200 feet long and range from 3 to 35 acres in size.

Typically, the surface layer is black silty clay loam about 9 inches thick. The subsoil is silty clay loam about 20 inches thick. The upper part is dark brown, and the lower part is dark yellowish brown. The underlying material to a depth of about 60 inches is olive brown and grayish brown silty clay loam. It is mottled in the lower part.

Included with this soil in mapping are small areas of the more sloping, eroded Poinsett soils and areas of Barnes and Sinai soils. The eroded Poinsett soils are on the convex parts of side slopes. The well drained Barnes soils are in areas where glacial till has been exposed or the silty surface layer is thin. The moderately well drained, nearly level Sinai soils formed in clayey sediments in slightly concave areas. Also included are small areas of sand and gravel. Included soils make up about 5 to 15 percent of the unit.

Permeability is moderate in the Poinsett soil. Available water capacity is high. Organic matter content also is high. Surface runoff is medium.

This soil is used mainly for cultivated crops. It is well suited to most of the crops commonly grown in the county. Water erosion is the main hazard. Conservation tillage practices, such as chisel plowing, help to control erosion and soil blowing. Leaving crop residue on the surface and keeping the surface rough reduce the risk of soil blowing on fall-tilled fields during winter and spring. A single-row field windbreak also helps to control soil blowing. An occasional green manure or sod crop helps to maintain good soil structure and tilth. Grassed waterways are needed in areas where runoff flows across this soil.

The land capability classification is IIe.

284B2—Poinsett silty clay loam, 3 to 6 percent slopes, eroded. This gently sloping, well drained soil is on convex side slopes on moraines. Erosion has exposed the subsoil in places. Individual areas are 75 to 200 feet long and range from 3 to 30 acres in size.

Typically, the surface layer is very dark grayish brown silty clay loam about 7 inches thick. The subsoil is about 16 inches thick. The upper part is dark brown silty clay loam, and the lower part is yellowish brown silt loam. The underlying material to a depth of about 60 inches is olive brown and grayish brown silt loam.

Included with this soil in mapping are small areas of the very gently sloping Poinsett soils and areas of Barnes, Buse, and Sinai soils. The very gently sloping Poinsett soils are on hilltops. The well drained Barnes and Buse soils are in areas where glacial till has been exposed or the silty surface layer is thin. The moderately well drained Sinai soils formed in clayey sediments in slightly concave areas. Also included are small areas of sand and gravel. Included soils make up about 5 to 15 percent of the unit.

Permeability is moderate in the Poinsett soil. Available water capacity is high. Organic matter content is moderate. Surface runoff is medium.

This soil is used mainly for cultivated crops. It is fairly well suited to most of the crops commonly grown in the county. Water erosion is the main hazard. The long, smooth slopes are suitable for farming on the contour and for terracing. Conservation tillage practices help to control water erosion, particularly in areas that are not suitable for contour farming. Leaving the surface rough and keeping crop residue on the surface increase the rate of water infiltration and reduce the hazard of soil blowing on fall-tilled fields. In some areas tilth is poor because of a loss of organic matter through erosion. Including green manure or sod crops in the cropping sequence improves soil structure and tilth. Grassed waterways are needed in areas where runoff flows across this soil.

The land capability classification is IIIe.

297B—Vienna silty clay loam, 2 to 4 percent slopes. This gently undulating, well drained soil is in convex areas on loess-mantled ground moraines. Individual areas are about 150 to 250 feet long and range from 3 to several hundred acres in size.

Typically, the surface layer is black silty clay loam

about 10 inches thick. The subsoil is about 17 inches thick. It is dark brown silty clay loam in the upper part, dark yellowish brown clay loam in the next part, and dark yellowish brown and pale brown clay loam in the lower part. The underlying material to a depth of about 60 inches is yellowish brown and pale brown clay loam.

Included with this soil in mapping are small areas of the more sloping Vienna soils and the moderately well drained Lismore soils. Lismore soils are on foot slopes and in slightly concave areas. Included soils make up about 5 to 10 percent of the unit.

Permeability is moderate in the upper part of the Vienna soil and moderately slow in the lower part. Available water capacity is high. Organic matter content is moderate or high. Surface runoff is slow or medium.

This soil is used mainly for cultivated crops. It is well suited to most of the crops commonly grown in the county. Water erosion is the main hazard. The long, gentle slopes are well suited to contour farming. Conservation tillage methods, such as chisel plowing, help to control erosion. Keeping crop residue on the surface and leaving the surface rough can reduce the hazard of soil blowing on fall-tilled fields. Including small grain and hay in the cropping sequence helps to maintain good soil structure and tilth. Grassed waterways are needed where runoff crosses this soil.

The land capability classification is IIe.

297B2—Vienna silty clay loam, 3 to 6 percent slopes, eroded. This gently sloping, well drained soil is on convex side slopes on loess-mantled ground moraines. Erosion has exposed the subsoil in places. Individual areas are about 100 to 200 feet long and range from 3 to several hundred acres in size.

Typically, the surface layer is very dark grayish brown silty clay loam about 6 inches thick. The subsoil is dark yellowish brown clay loam about 18 inches thick. The underlying material to a depth of about 60 inches is yellowish brown and light yellowish brown clay loam.

Included with this soil in mapping are areas of the less sloping or more sloping Vienna soils. Also included are small areas of the moderately well drained Lismore soils on foot slopes and on the slightly concave parts of the landscape. Included soils make up about 5 to 10 percent of the unit.

Permeability is moderate in the upper part of the Vienna soil and moderately slow in the lower part. Available water capacity is high. Organic matter content is moderate. Surface runoff is medium.

This soil is used mainly for cultivated crops. It is well suited to most of the crops commonly grown in the county. Water erosion is the main hazard. The gentle, long slopes generally are well suited to contour farming and terracing. A system of conservation tillage that leaves the surface rough and keeps crop residue on the surface reduces the risk of erosion on fall-tilled fields. It is especially needed where slopes are too irregular for contour farming. A single-row field windbreak can help to control soil blowing. In some areas tilth is poor because of a loss of organic matter through erosion. Including small grain and hay in the cropping sequence improves soil structure and tilth. Grassed waterways are needed where runoff crosses this soil.

The land capability classification is IIe.

339A—Fordville loam, 0 to 2 percent slopes. This nearly level, well drained soil is on flats on stream terraces, outwash plains, and uplands. Individual areas range from 3 to 65 acres in size. Those in the uplands and on outwash plains are irregular in shape, and those along stream terraces are long and narrow.

Typically, the surface layer is black loam about 11 inches thick. The subsoil is about 18 inches thick. It is very dark gray loam in the upper part, very dark grayish brown loam in the next part, and brown sandy loam in the lower part. The underlying material to a depth of about 60 inches is dark brown gravelly sand. In some areas the underlying material is not gravelly. In other areas the subsoil is calcareous. In places the sandy and gravelly underlying material is only a few feet thick over silty material or glacial till.

Included with this soil in mapping are small areas of the more sloping Fordville soils and the somewhat excessively drained Arvilla soils. Arvilla soils are shallow to gravelly underlying material. Included soils make up about 2 to 10 percent of the unit.

Permeability is moderate in the upper part of the Fordville soil and rapid in the lower part. Available water capacity is moderate. Organic matter content is high. Surface runoff is slow.

This soil is used mainly for cultivated crops. It is well suited to most of the crops commonly grown in the county. Droughtiness is the major limitation, and soil blowing is a hazard. Leaving crop residue on the surface during winter helps to control soil blowing, traps snow, and provides moisture for the next crop. The surface layer can be worked easily into a good seedbed. Applying manure and including small grain and hay in the cropping sequence improve fertility, maintain the organic matter content, and increase the amount of available water. Grassed waterways in the drainageways that cross this soil generally prevent gullying.

This soil is well suited to irrigation. It can be row

cropped intensively if water for irrigation is available.

The land capability classification is IIs.

339B—Fordville loam, 2 to 6 percent slopes. This well drained soil is on knolls and side slopes on stream terraces, outwash plains, and uplands. It is gently sloping on the stream terraces and outwash plains and undulating in the uplands. Individual areas range from 3 to 25 acres in size. Those in the uplands and on outwash plains are irregular in shape, and those along stream terraces are long and narrow.

Typically, the surface layer is black loam about 7 inches thick. The subsoil is about 20 inches thick. It is very dark gray loam in the upper part, very dark grayish brown loam in the next part, and brown sandy clay loam in the lower part. The upper part of the underlying material is dark brown gravelly loamy sand. The lower part to a depth of about 60 inches is olive brown gravelly sand. In some places tillage has mixed part of the subsoil into the surface layer after erosion has occurred. In other places the underlying material is fine sand. In some areas the sandy and gravelly underlying material is only a few feet thick over silty alluvium or glacial till.

Included with this soil in mapping are small areas of the somewhat excessively drained Arvilla soils. These soils are shallow to gravelly underlying material. They make up about 2 to 10 percent of the unit.

Permeability is moderate in the upper part of the Fordville soil and rapid in the lower part. Available water capacity is moderate. The content of organic matter is high. Surface runoff is medium.

This soil is used mainly for cultivated crops. It is well suited to most of the crops commonly grown in the county. Water erosion is the main hazard. Leaving crop residue on the surface during winter traps snow and helps to provide moisture for the next crop. Grassed waterways help to prevent the formation of gullies, which can cut into the sandy and gravelly underlying material.

The land capability classification is IIe.

341A—Arvilla sandy loam, 0 to 2 percent slopes. This nearly level, somewhat excessively drained soil is on stream terraces, outwash plains, and moraines. Individual areas are irregular in shape and range from 3 to 160 acres in size.

Typically, the surface layer is very dark gray sandy loam about 8 inches thick. The subsoil is dark brown sandy loam about 11 inches thick. The underlying material to a depth of about 60 inches is pale brown and yellowish brown gravelly coarse sand. In some areas the brownish subsoil is exposed. In other areas the surface layer and subsoil are calcareous. In some places the surface is stony. In other places glacial till is below a depth of 40 inches.

Included with this soil in mapping are small areas of Sioux and Fordville soils. The excessively drained Sioux soils are in old stream meanders and on escarpments. The well drained Fordville soils are in slightly concave areas. Included soils make up about 3 to 10 percent of the unit.

Permeability is moderately rapid in the upper part of the Arvilla soil and rapid or very rapid in the lower part. Available water capacity is low. Organic matter content is moderately low or moderate. Surface runoff is slow.

This soil is used mainly for cultivated crops. It is fairly well suited to most of the crops commonly grown in the county. Droughtiness is the major limitation, and soil blowing is a hazard. Leaving crop residue on the surface during winter helps to control soil blowing, traps snow, and conserves moisture. Conservation tillage practices, such as chisel plowing, reduce the risk of soil blowing and conserve moisture. A single-row field windbreak reduces the risk of soil blowing and the loss of moisture through evaporation and transpiration. Stripcropping, in which close-growing crops and row crops are grown in alternating narrow bands, also helps to prevent excessive soil and moisture loss.

The land capability classification is IIIs.

341B—Arvilla sandy loam, 2 to 6 percent slopes. This somewhat excessively drained soil is on knolls and side slopes on gently sloping stream terraces and outwash plains and on undulating moraines. Individual areas are 50 to 150 feet long and range from 3 to 75 acres in size.

Typically, the surface layer is very dark gray sandy loam about 8 inches thick. The subsoil is dark brown sandy loam about 11 inches thick. The underlying material to a depth of about 60 inches is pale brown and light yellowish brown gravelly coarse sand. In cultivated areas the surface layer is somewhat lighter in color as a result of erosion and the loss of organic matter. In a few areas erosion has exposed the brownish subsoil. In some places the surface layer and subsoil are calcareous. In other places the surface is stony. In some areas glacial till is below a depth of 40 inches.

Included with this soil in mapping are small areas of Sioux and Fordville soils. The excessively drained Sioux soils are on exposed hilltops and escarpments. The well

drained Fordville soils are in slightly concave spots and in drainageways. Included soils make up about 5 to 10 percent of the unit.

Permeability is moderately rapid in the upper part of the Arvilla soil and rapid or very rapid in the lower part. Available water capacity is low. Organic matter content is moderately low or moderate. Surface runoff is medium.

This soil is used mainly for cultivated crops. It is fairly well suited to most of the crops commonly grown in the county. Water erosion is the main hazard, and droughtiness is a limitation. Applying a system of conservation tillage and returning crop residue to the soil help to control erosion and conserve moisture in areas where slopes are too irregular for contour farming. Leaving residue on the surface during winter helps to control soil blowing, traps snow, and conserves moisture. A single-row field windbreak also helps to control soil blowing and conserves moisture.

The land capability classification is IIIe.

341C—Arvilla sandy loam, 6 to 12 percent slopes. This sloping, somewhat excessively drained soil is on convex side slopes and ridges on moraines and on escarpments on stream terraces. Individual areas are 50 to 125 feet long and range from 3 to 25 acres in size.

Typically, the surface layer is very dark gray sandy loam about 8 inches thick. The subsoil is dark brown sandy loam about 11 inches thick. The underlying material to a depth of about 60 inches is pale brown and yellowish brown gravelly coarse sand. In cultivated areas the surface layer generally is lighter in color and is not so thick. In some places a few stones are on and below the surface. In other places the deposits of gravel are only a few feet thick over glacial till or silty alluvium.

Included with this soil in mapping are small areas of the excessively drained Sioux soils. These soils are on the most exposed parts of side slopes and hilltops. They have gravel and cobbles on the surface. They make up about 5 to 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Arvilla soil and rapid or very rapid in the lower part. Available water capacity is low. Organic matter content is moderately low or moderate. Surface runoff is medium.

This soil is poorly suited to most of the crops commonly grown in the county. Water erosion is the main hazard. Spring tillage, heavy applications of manure, and crop residue management are needed. Terraces generally are not constructed on this soil because it is too shallow over gravelly sand. In waterways where water erosion has exposed the gravelly sand, replacing the top layer promotes the growth of grass. Gullies should be shaped and seeded to form grassed waterways.

The land capability classification is IVe.

344—Quam silty clay loam. This nearly level, very poorly drained soil is in depressions and drainageways on moraines. It is subject to ponding. Individual areas are irregular in shape and range from 3 to 60 acres in size.

Typically, the surface layer is black silty clay loam about 10 inches thick. The subsurface layer also is black silty clay loam. It is about 47 inches thick. The underlying material to a depth of about 60 inches is olive gray, mottled silty clay loam. In some large depressions, the soil is overlain by a layer of muck as much as 15 inches thick. In some areas free lime is at or near the surface.

Included with this soil in mapping are areas of the poorly drained Vallers and Marysland soils on the narrow rims of the depressions and areas of the well drained Sverdrup soils on sandy beaches adjacent to the larger depressions. Also included are areas of the clayey Fulda soils on the outer edge of the depressions. Included soils make up about 3 to 10 percent of the unit.

Permeability is moderately slow in the Quam soil. Available water capacity is high. Organic matter content is high or very high. Surface runoff is very slow or ponded. The seasonal high water table is 2 feet above to 1 foot below the surface.

This soil is used mainly for cultivated crops. If drained, it is fairly well suited to most of the crops commonly grown in the county. The wetness is the main limitation. Open ditches can drain away surface water and in places can provide outlets for tile drainage systems. Fall tillage permits earlier preparation of a seedbed in spring. A system of conservation tillage that leaves the fields rough and keeps crop residue on the surface can reduce the hazard of soil blowing. Measures that minimize compaction and maintain good tilth are needed. If the soil is worked when very wet, hard clods can form. An occasional sod or green manure crop helps to maintain good tilth in the surface layer.

The land capability classification is IIIw.

345—Wilmonton clay loam. This nearly level, moderately well drained soil is on plane and slightly concave hilltops and in long, narrow areas adjacent to drainageways on moraines. Individual areas are

irregular in shape and range from 3 to several hundred acres in size.

Typically, the surface layer is black clay loam about 8 inches thick. The subsurface layer is very dark gray clay loam about 7 inches thick. The subsoil is clay loam about 9 inches thick. The upper part is very dark grayish brown, and the lower part is brown and mottled. The underlying material to a depth of about 60 inches is light olive brown and light yellowish brown, mottled clay loam.

Included with this soil in mapping are small areas of Letri, Everly, and Glencoe soils. The poorly drained Letri soils are in shallow drainageways. The well drained Everly soils are on gently undulating knolls and side slopes in areas above deep drainageways. The very poorly drained Glencoe soils are in shallow depressions. Included soils make up about 5 to 15 percent of the unit.

Permeability is moderately slow in the Wilmonton soil. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The seasonal high water table is at a depth of 2.5 to 5.0 feet.

This soil is used mainly for cultivated crops. It is well suited to most of the crops commonly grown in the county.

The land capability classification is I.

359—Lamoure silty clay loam, frequently flooded. This nearly level, poorly drained soil is on flood plains. Individual areas are long and narrow and range from 3 to 200 acres in size.

Typically, the surface layer is black silty clay loam about 11 inches thick. The subsurface layer is silty clay loam about 29 inches thick. It is black in the upper part and very dark gray in the lower part. The underlying material to a depth of about 60 inches is dark gray, mottled silty clay loam. In some areas along streams, sandy, gravelly, and stony material has been deposited.

Included with this soil in mapping are small areas of very poorly drained soils in oxbows and stream channels and narrow areas of the moderately well drained La Prairie and Terril soils on the slightly higher parts of the flood plains. Included soils make up about 5 to 15 percent of the unit.

Permeability is moderately slow or moderate in the Lamoure soil. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The seasonal high water table is within a depth of 2 feet.

This soil generally is unsuited to cultivated crops because of wetness and flooding.

The land capability classification is VIw.

392—Biscay loam. This nearly level, poorly drained soil is on low flats and in drainageways on outwash plains, on moraines, and in overflow channels. Individual areas are irregular in shape and range from 10 to 60 acres in size.

Typically, the surface layer is black loam about 10 inches thick. The subsurface layer is loam about 12 inches thick. It is black in the upper part and very dark gray in the lower part. The subsoil is about 16 inches thick. It is olive gray, mottled loam in the upper part and olive, mottled gravelly loam in the lower part. The underlying material to a depth of about 60 inches is olive gray, stratified gravelly loamy sand and loamy coarse sand.

Included with this soil in mapping are small areas of the poorly drained, silty Lamoure soils on flood plains and the well drained Fordville soils on small knolls. Included soils make up about 5 to 10 percent of the unit.

Permeability is moderate in the upper part of the Biscay soil and rapid in the lower part. Available water capacity is moderate. Organic matter content is high. Surface runoff is slow. Depth to the seasonal high water table is 1 to 3 feet.

This soil is used mainly for cultivated crops. If drained, it is well suited to most of the crops commonly grown in the county. The wetness is the main limitation. Fall tillage allows the soil to warm up and dry out sooner in the spring. A system of conservation tillage that leaves the surface rough and keeps crop residue on the surface helps to maintain good tilth and reduces the hazard of soil blowing.

The land capability classification is IIw.

402E—Sioux sandy loam, 2 to 40 percent slopes. This gently undulating to very steep, excessively drained soil is on terrace escarpments along streambeds, on lakeshores, and on gravelly ridges on moraines. Individual areas are irregular in shape and range from 4 to 25 acres in size.

Typically, the surface layer is black sandy loam about 7 inches thick. The next 6 inches is dark brown gravelly sandy loam. The underlying material to a depth of about 60 inches is yellowish brown very gravelly sand. Most areas are stony. In a few places the surface layer is leached of free lime. In some areas it is gravelly. In places the gravelly underlying material is only a few feet thick over glacial till or silty alluvium.

Included with this soil in mapping are small areas of Arvilla and Fordville soils. These soils are on the less exposed parts of side slopes and escarpments. They are deeper to gravelly underlying material than the

Sioux soil and are less droughty. They make up about 5 to 15 percent of the unit.

Permeability is rapid or very rapid in the Sioux soil. Available water capacity is low. Organic matter content is moderately low or moderate. Surface runoff is slow to rapid.

This soil generally is unsuited to cultivated crops because of the droughtiness and the slope.

The land capability classification is VIs.

418—Lamoure silty clay loam, occasionally flooded. This nearly level, poorly drained soil is on flood plains. It is a few feet higher than the stream channels. Individual areas are long and narrow and range from 20 to several hundred acres in size.

Typically, the surface layer is black silty clay loam about 11 inches thick. The subsurface layer is silty clay loam about 29 inches thick. It is black in the upper part and very dark gray in the lower part. The underlying material to a depth of about 60 inches is dark gray, mottled silty clay loam. In places the soil has thin strata of sand or silt.

Included with this soil in mapping are small areas of the moderately well drained La Prairie soils on the slightly higher parts of the flood plains. Also included are ponded areas on the lower parts of the flood plains. Included areas make up about 5 to 10 percent of the unit.

Permeability is moderately slow or moderate in the Lamoure soil. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The seasonal high water table is within a depth of 2 feet.

This soil is used mainly for cultivated crops. If drained, it is well suited to most of the crops commonly grown in the county. The wetness is the main limitation, and the occasional flooding is a hazard. Ditching and channel straightening can improve drainage and decrease the hazard of flooding. Soil blowing is a hazard in large open areas. It can be controlled by a system of conservation tillage that keeps crop residue on the surface.

The land capability classification is IIw.

436—Hidewood silty clay loam. This nearly level, poorly drained soil is in drainageways and on low flats on loess-mantled moraines. It is subject to rare flooding. Individual areas range from 3 to 150 acres in size.

Typically, the surface layer is black silty clay loam about 8 inches thick. The subsurface layer is silty clay loam about 13 inches thick. It is black in the upper part and very dark gray in the lower part. The subsoil is grayish brown, mottled silty clay loam about 10 inches thick. The underlying material to a depth of about 60 inches is olive and light olive gray, mottled loam and clay loam.

Included with this soil in mapping are small areas of the moderately well drained Lismore soils on the upper part of drainageways. Included soils make up about 5 to 10 percent of the unit.

Permeability is moderately slow or moderate in the Hidewood soil. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The seasonal high water table is at a depth of 1 to 3 feet in the spring and during other wet periods.

This soil is used mainly for cultivated crops. If drained, it is well suited to most of the crops commonly grown in the county. The wetness is the main limitation. If the soil is worked when it is very wet, severe compaction and clodding of the surface layer are likely to occur. Large open areas are subject to soil blowing. A system of conservation tillage that incorporates crop residue into the surface layer helps to maintain good tilth and reduces the hazard of soil blowing. Grassed waterways are needed in areas where water flows across this soil.

The land capability classification is IIw.

437F—Buse loam, 18 to 40 percent slopes. This steep and very steep, well drained soil is on side slopes and ridges along rivers, creeks, and deep drainageways on moraines. Individual areas are long and narrow and range from 3 to 100 acres in size.

Typically, the surface layer is very dark gray loam about 7 inches thick. The subsoil is dark yellowish brown loam about 15 inches thick. The underlying material to a depth of about 60 inches is yellowish brown and light olive brown loam and clay loam. In most areas a few stones and boulders are on and below the surface. In some places part or all of the surface layer has no free lime. In other places the surface layer contains more clay.

Included with this soil in mapping are narrow areas of the poorly drained Lamoure and moderately well drained La Prairie soils along the drainageways that dissect the landscape. Also included are the moderately well drained Terril soils on the concave parts of foot slopes and sandy and gravelly spots on shoulder slopes. Included soils make up about 5 to 15 percent of the unit.

Permeability is moderate in the Buse soil. Available water capacity is high. Organic matter content is moderately low or moderate. Surface runoff is rapid.

This soil generally is unsuited to cultivated crops because of the hazard of water erosion and the slope.

The land capability classification is VIIe.

470—Lismore silty clay loam. This nearly level, moderately well drained soil is on plane and slightly concave side slopes and in the upper part of drainageways on moraines. Individual areas range from 3 to several hundred acres in size.

Typically, the surface layer is black silty clay loam about 8 inches thick. The subsurface layer also is black silty clay loam. It is about 7 inches thick. The subsoil is clay loam about 16 inches thick. It is very dark grayish brown in the upper part and dark grayish brown in the lower part. The underlying material to a depth of about 60 inches is light olive brown clay loam.

Included with this soil in mapping are small areas of Vienna and Hidewood soils. The well drained Vienna soils are on the higher parts of the landscape. The poorly drained Hidewood soils are in drainageways. Included soils make up about 5 to 15 percent of the unit.

Permeability is moderate in the upper part of the Lismore soil and moderately slow in the lower part. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The seasonal high water table is at a depth of 4 to 6 feet.

This soil is used mainly for cultivated crops. It is well suited to most of the crops commonly grown in the county.

The land capability classification is I.

506—Overly silty clay loam. This nearly level, moderately well drained soil is on slightly convex knolls and peninsulas on lake plains in the uplands. Individual areas are irregular in shape and range from 3 to 75 acres in size.

Typically, the surface layer is black silty clay loam about 8 inches thick. The subsurface layer also is black silty clay loam. It is about 6 inches thick. The next layer is very dark grayish brown silty clay loam about 5 inches thick. The subsoil is brown silty clay loam about 7 inches thick. The underlying material to a depth of about 60 inches is light olive brown and grayish brown, mottled silty clay loam.

Included with this soil in mapping are small areas of the poorly drained Spicer and Fulda soils on the lower parts of the landscape. Also included are spots of the very poorly drained Lura soils in depressions and small areas of the well drained Sverdrup and somewhat excessively drained Arvilla soils in the higher landscape positions. Included soils make up about 5 to 15 percent of the unit.

Permeability is moderately slow in the upper part of the Overly soil and moderately slow or slow in the lower part. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The seasonal high water table is at a depth of 4 to 6 feet.

This soil is used mainly for cultivated crops. It is well suited to most of the crops commonly grown in the county.

The land capability classification is I.

562—Knoke silty clay loam. This level, very poorly drained soil is in the drained basins of shallow lakes and ponds on till plains. It is subject to ponding. Individual areas range from 3 to several hundred acres in size.

Typically, the surface layer is black silty clay loam about 10 inches thick. The subsurface layer is silty clay loam about 27 inches thick. It is black in the upper part and very dark gray and mottled in the lower part. The subsoil to a depth of about 60 inches is very dark gray and olive gray, mottled silty clay. In some areas the surface layer does not have free carbonates.

Included with this soil in mapping are small areas of the poorly drained Canisteo soils on the edges of depressions. Also included are poorly drained, sandy soils in beach areas along the edge of old lakebeds. Included soils make up about 5 to 15 percent of the unit.

Permeability is moderately slow in the Knoke soil. Available water capacity is high. Organic matter content is very high. Surface runoff is slow to ponded. The seasonal high water table is 1 foot above to 1 foot below the surface.

This soil is used mainly for cultivated crops. If drained, it is fairly well suited to most of the crops commonly grown in the county. The wetness is the main limitation. Soil blowing is a hazard, especially in winter and spring. Timely fieldwork at the proper moisture content and a system of conservation tillage that keeps large amounts of crop residue on the surface can help to maintain good tilth and reduce the hazard of soil blowing. Fall tillage allows for earlier planting in the spring. Applications of potassium and phosphorus fertilizer generally are needed to offset the effects of a high content of lime.

The land capability classification is IIIw.

590—Moines clay loam. This nearly level, somewhat poorly drained soil is on slightly convex knolls in low areas on moraines. Individual areas are irregular in shape and range from 2 to 30 acres in size.

Typically, the surface layer is black clay loam about 10 inches thick. The subsurface layer is very dark gray

clay loam about 4 inches thick. The subsoil is friable loam about 26 inches thick. The upper part is olive brown, and the lower part is light olive brown. The underlying material to a depth of about 60 inches is light yellowish brown, mottled loam.

Included with this soil in mapping are small areas of the poorly drained, calcareous Jeffers soils on low flats, the moderately well drained Wilmonton soils on rises, and the very poorly drained Glencoe soils in depressions. Included soils make up about 5 to 15 percent of the unit.

Permeability is moderate in the upper part of the Moines soil and moderately slow in the lower part. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The seasonal high water table is at a depth of 1.5 to 4.0 feet.

This soil is used mainly for cultivated crops. It is well suited to most of the crops commonly grown in the county. Applications of potassium and phosphorus fertilizer help to correct the fertility imbalance caused by a high content of lime and gypsum. Soybeans grown on this soil commonly are affected by chlorosis, which results from a lack of available iron. This limitation can be overcome by growing varieties of soybeans that can tolerate excess lime.

The land capability classification is IIs.

594—Jeffers clay loam. This nearly level, poorly drained soil is on low flats and the edges of depressions on moraines. Individual areas are irregular in shape and range from 3 to 150 acres in size.

Typically, the surface layer is black clay loam about 10 inches thick. The subsurface layer is very dark gray clay loam about 8 inches thick. The subsoil is mottled clay loam about 17 inches thick. It is dark grayish brown in the upper part, grayish brown in the next part, and light olive brown in the lower part. The underlying material to a depth of about 60 inches is light olive brown, mottled clay loam.

Included with this soil in mapping are small areas of the very poorly drained Glencoe soils in depressions, the poorly drained, noncalcareous Letri soils in swales, and the somewhat poorly drained Moines soils on knolls. Included soils make up about 5 to 15 percent of the unit.

Permeability is moderate in the upper part of the Jeffers soil and moderately slow in the lower part. Available water capacity is high. Organic matter content also is high. Surface runoff is slow. The seasonal high water table is at a depth of 1 to 2 feet.

This soil is used mainly for cultivated crops. If drained, it is well suited to most of the crops commonly grown in the county. The wetness is the main limitation. If crop growth is poor even after an adequate drainage system has been installed, applications of potassium and phosphorus fertilizer are needed to correct the fertility imbalance caused by a high content of lime and gypsum. Soybeans grown on this soil commonly are affected by chlorosis, which results from a lack of available iron. This limitation can be overcome by installing a drainage system and by growing varieties of soybeans that can tolerate excess lime. Severe compaction and clodding of the surface layer are likely if the soil is worked when it is very wet. Fall tillage results in a drier seedbed in the spring. Large open areas are subject to soil blowing. A system of conservation tillage that leaves the surface rough and keeps crop residue on the surface helps to maintain good tilth and reduces the hazard of soil blowing.

The land capability classification is IIw.

894D2—Storden-Everly complex, 12 to 18 percent slopes, eroded. These moderately steep, well drained soils are on side slopes and at the head of drainageways on moraines. The Storden soil is on the steepest parts of the side slopes, and the Everly soil is on the less sloping parts. Erosion has exposed the subsoil in places. Individual areas are irregular in shape and range from 3 to 20 acres in size. They are about 55 percent Storden soil and 40 percent Everly soil. The two soils occur as areas so intricately mixed that separating them in mapping was not practical.

Typically, the Storden soil has a surface layer of dark grayish brown loam about 8 inches thick. The underlying material to a depth of about 60 inches is olive brown and light olive brown loam. In places part or all of the surface layer has no free lime.

Typically, the Everly soil has a surface layer of very dark grayish brown loam about 8 inches thick. The subsoil is friable clay loam about 18 inches thick. The upper part is dark yellowish brown and has many very dark gray worm casts, and the lower part is yellowish brown. The underlying material to a depth of about 60 inches is brown and yellowish brown loam. In some areas the soil does not have free lime. In places the surface layer is lighter colored.

Included with these soils in mapping are small areas of the less sloping Everly and more sloping Storden soils on side slopes. Also included are small areas of Letri and Terril soils. The poorly drained Letri soils are in narrow drainageways that dissect the landscape. The moderately well drained Terril soils are on concave foot slopes. Included soils make up about 5 percent of the unit.

Permeability is moderate in the Storden and Everly soils. Available water capacity is high. Organic matter content is low. Surface runoff is rapid.

These soils are poorly suited to most of the crops commonly grown in the county. Water erosion is the main hazard. In some areas tilth is poor because of the loss of organic matter through erosion. Contour stripcropping, spring tillage, and conservation tillage help to control erosion. If stripcropping is not practical, erosion can be controlled by including hay or pasture crops in the cropping sequence. Grassed waterways are needed in areas where runoff flows across these soils. Heavy applications of manure increase productivity and improve tilth in eroded areas.

The land capability classification of the Storden soil is IVe, and that of the Everly soil is IIIe.

902C2—Barnes-Buse loams, 6 to 12 percent slopes, eroded. These rolling, well drained soils are on convex side slopes on moraines. The Buse soil is on the steepest parts of the side slopes, and the Barnes soil is on the less sloping parts. Erosion has exposed the subsoil in places. Individual areas are 50 to 100 feet long and range from 3 to 100 acres in size. They are about 50 percent Barnes soil and 35 percent Buse soil. The two soils occur as areas so intricately mixed that separating them in mapping was not practical.

Typically, the Barnes soil has a surface layer of very dark grayish brown loam about 8 inches thick. The subsoil is loam about 24 inches thick. It is dark brown in the upper part and dark yellowish brown in the lower part. The underlying material to a depth of about 60 inches is light olive brown loam. In places the surface layer is black and is a few inches thicker.

Typically, the Buse soil has a surface layer of very dark grayish brown loam about 7 inches thick. The subsoil is dark yellowish brown loam about 15 inches thick. The underlying material to a depth of about 60 inches is yellowish brown and light olive brown loam. In some areas the soil has many dark brown worm casts and root channels in the upper part. In other areas a 4-inch layer of very dark grayish brown, dark brown, and yellowish brown loam that has many worm casts and root channels is below the surface layer.

Included with these soils in mapping are small areas of the less sloping Barnes and more sloping Buse soils on side slopes. Also included are areas where gravelly material is exposed on knolls and the upper parts of hillsides and areas of the moderately well drained Terril soils on the concave parts of foot slopes. Included soils make up about 15 percent of the unit.

Permeability is moderate in the Barnes and Buse soils. Available water capacity is high. The content of organic matter is moderately low or moderate in the Barnes soil and moderately low in the Buse soil. Surface runoff is medium on both soils.

These soils are fairly well suited to most of the crops commonly grown in the county. Water erosion is the main hazard. In some areas tilth is poor because of the loss of organic matter through erosion. Grassed waterways are needed in areas where runoff collects and flows across these soils. In some areas the slopes are suitable for terracing and farming on the contour. Including small grain and hay crops in the cropping sequence helps to control runoff and erosion and improves soil structure and tilth. Growing a winter cover crop, applying manure, and returning crop residue to the soil help to control erosion.

The land capability classification is IIIe.

904B—Arvilla-Barnes-Buse complex, 2 to 6 percent slopes. These undulating soils are on convex hilltops and side slopes on moraines. The somewhat excessively drained Arvilla soil is on ridges and hilltops, the well drained Barnes soil is on the lower parts of side slopes, and the well drained Buse soil is on the upper, more convex parts of the side slopes. Individual areas are 75 to 150 feet long and range from 3 to 40 acres in size. They are about 40 percent Arvilla soil, 35 percent Barnes soil, and 15 percent Buse soil. The three soils occur as areas so intricately mixed that separating them in mapping was not practical.

Typically, the Arvilla soil has a surface layer of very dark gray sandy loam about 8 inches thick. The subsoil is dark brown sandy loam about 11 inches thick. The underlying material to a depth of about 60 inches is pale brown and yellowish brown gravelly coarse sand. In some places the underlying material is loamy. In other places the surface layer is thicker.

Typically, the Barnes soil has a surface layer of very dark gray loam about 8 inches thick. The subsoil is loam about 24 inches thick. It is dark brown in the upper part and dark yellowish brown in the lower part. The underlying material to a depth of about 60 inches is light olive brown loam.

Typically, the Buse soil has a surface layer of very dark grayish brown loam about 7 inches thick. The subsoil is dark yellowish brown loam about 15 inches thick. The underlying material to a depth of about 60 inches is yellowish brown and light olive brown loam. In some areas many dark brown worm casts and root channels are in the upper part of the subsoil.

Included with these soils in mapping are small areas of Sioux and Fordville soils. The excessively drained

Sioux soils are on the upper parts of ridges and escarpments. The well drained Fordville soils are in slightly concave areas. Included soils make up about 10 percent of the unit.

Permeability is moderately rapid in the upper part of the Arvilla soil and rapid or very rapid in the lower part. It is moderate in the Barnes and Buse soils. Available water capacity is low in the Arvilla soil and high in the Buse and Barnes soils. Surface runoff is slow or medium on all three soils. The content of organic matter is moderately low or moderate in the Arvilla and Buse soils and moderate or high in the Barnes soil.

These soils are used mainly for cultivated crops. They are fairly well suited to most of the crops commonly grown in the county. Water erosion is the main hazard. Droughtiness is a moderate limitation in the Arvilla soil. The main management needs are measures that control erosion, conserve water, and improve fertility. In areas where slopes are too irregular for contour farming, applying a system of conservation tillage and returning crop residue to the soil help to prevent excessive soil loss. These measures are particularly effective in controlling soil blowing during the winter. Including small grain and hay crops in the cropping sequence helps to control runoff and erosion and improves tilth. Leaving crop residue on the surface during winter helps to trap snow and conserves moisture. A single-row field windbreak helps to control soil blowing and conserves moisture.

The land capability classification of the Arvilla soil is IIIe, and that of the Barnes and Buse soils is IIe.

904C—Arvilla-Barnes-Buse complex, 6 to 12 percent slopes. These rolling soils are on convex side slopes and ridges on moraines. The somewhat excessively drained Arvilla soil is on ridges and hilltops. The well drained Barnes soil is on the less sloping parts of side slopes, and the well drained Buse soil is on the steeper, more convex parts of the side slopes. Individual areas are 50 to 150 feet long and range from 3 to 50 acres in size. They are about 40 percent Arvilla soil, 25 percent Barnes soil, and 25 percent Buse soil. The three soils occur as areas so intricately mixed that separating them in mapping was not practical.

Typically, the Arvilla soil has a surface layer of very dark gray sandy loam about 8 inches thick. The subsoil is dark brown sandy loam about 11 inches thick. The underlying material to a depth of about 60 inches is pale brown and yellowish brown gravelly coarse sand. In some areas the deposits of gravel are only a few feet thick over glacial till.

Typically, the Barnes soil has a surface layer of very dark gray loam about 8 inches thick. The subsoil is loam about 24 inches thick. It is dark brown in the upper part and dark yellowish brown in the lower part. The underlying material to a depth of about 60 inches is olive brown and light olive brown loam. In places the surface layer is black and is thicker.

Typically, the Buse soil has a surface layer of very dark grayish brown loam about 7 inches thick. The subsoil is dark yellowish brown loam about 15 inches thick. The underlying material to a depth of about 60 inches is yellowish brown and light olive brown loam. In some areas the soil has many dark brown worm casts and root channels in the upper part. In other areas a 4-inch layer of very dark grayish brown, dark brown, and yellowish brown loam that has many worm casts and root channels is below the surface layer.

Included with these soils in mapping are small areas of Sioux and Terril soils. The excessively drained Sioux soils are on hillcrests where gravelly material is exposed. The moderately well drained Terril soils are on foot slopes and in drainageways. They have a thick, dark surface layer. Included soils make up about 10 percent of the unit.

Permeability is moderately rapid in the upper part of the Arvilla soil and rapid or very rapid in the lower part. It is moderate in the Buse and Barnes soils. Available water capacity is low in the Arvilla soil and high in the Buse and Barnes soils. The content of organic matter is moderately low or moderate in the Arvilla and Buse soils and moderate or high in the Barnes soil. Surface runoff is medium on all three soils.

These soils are poorly suited to most of the crops commonly grown in the county. Water erosion is the main hazard. The hazard of drought is severe on the Arvilla soil. The main management needs are measures that control erosion, conserve water, and improve fertility. Contour stripcropping, spring tillage, heavy applications of manure, and the incorporation of crop residue into the soil help to control water erosion and improve tilth. Terraces generally are not constructed on these soils because the Arvilla soil is shallow over gravelly sand. Grassed waterways are needed where runoff flows across these soils. Existing waterways should be maintained. If gravelly sand has been exposed by erosion in waterways, adding a layer of topsoil improves the growth of grasses.

The land capability classification of the Arvilla soil is IVe, and that of the Buse and Barnes soils is IIIe.

913D—Buse-Barnes loams, 12 to 18 percent slopes. These moderately steep, well drained soils are on convex side slopes and at the head of drainageways

on moraines. The Buse soil is on the steepest, upper parts of the side slopes, and the Barnes soil is on the less sloping parts. Individual areas are about 150 feet long and range from 3 to 15 acres in size. They are about 55 percent Buse soil and 35 percent Barnes soil. The two soils occur as areas so intricately mixed that separating them in mapping was not practical.

Typically, the Buse soil has a surface layer of very dark gray loam about 9 inches thick. The subsoil is dark yellowish brown loam about 15 inches thick. The underlying material to a depth of about 60 inches is yellowish brown loam. In places a 4-inch layer of very dark grayish brown, dark brown, and yellowish brown loam that has many worm casts and root channels is below the surface layer.

Typically, the Barnes soil has a surface layer of black loam about 11 inches thick. The subsoil is loam about 24 inches thick. It is dark brown in the upper part and dark yellowish brown in the lower part. The underlying material to a depth of about 60 inches is olive brown loam.

Included with these soils in mapping are small areas of the more sloping Buse soils on side slopes. Also included are small, narrow areas of the moderately well drained Terril soils on the concave parts of foot slopes and in drainageways and some areas of sandy and gravelly deposits on the crest of slopes. Included soils make up about 10 percent of the unit.

Permeability is moderate in the Buse and Barnes soils. Available water capacity is high. The content of organic matter is moderately low or moderate in the Buse soil and moderate or high in the Barnes soil. Surface runoff is rapid or very rapid on both soils.

These soils are poorly suited to most of the crops commonly grown in the county. Water erosion is the main hazard. It can be controlled by contour stripcropping, spring tillage, and conservation tillage. If stripcropping is not practical, water erosion can be controlled by including hay or pasture crops in the cropping sequence. Grassed waterways are needed where runoff flows across cropped areas. Heavy applications of manure increase productivity and improve tilth in eroded areas.

The land capability classification is IVe.

917D—Buse-Sioux complex, 12 to 18 percent slopes. These moderately steep soils are on ridges and side slopes and at the head of drainageways on moraines. The well drained Buse soil is on the more convex, upper side slopes. The somewhat excessively drained Sioux soil is on gravelly outwash ridges and on stream terrace escarpments. Individual areas are about 50 to 150 feet long and range from 3 to 15 acres in size. They are about 50 percent Buse soil and 40 percent Sioux soil. The two soils occur as areas so intricately mixed that separating them in mapping was not practical.

Typically, the Buse soil has a surface layer of very dark gray loam about 9 inches thick. The subsoil is dark yellowish brown loam about 15 inches thick. The underlying material to a depth of about 60 inches is yellowish brown loam. In some areas the soil has many dark brown worm casts and root channels in the upper part.

Typically, the Sioux soil has a surface layer of black sandy loam about 7 inches thick. The next layer is dark brown gravelly sandy loam about 6 inches thick. The underlying material to a depth of about 60 inches is light brownish gray and yellowish brown very gravelly sand. In areas where the soil has been cropped, the surface layer is very dark gray. In places gravel, cobbles, and small stones are on the surface.

Included with these soils in mapping are small areas of Barnes, Sverdrup, and Terril soils. The well drained Barnes soils are on the lower, convex side slopes. The well drained Sverdrup soils are on the crest of side slopes or in slightly concave areas. The moderately well drained Terril soils are on the concave part of foot slopes. Included soils make up about 10 percent of the unit.

Permeability is moderate in the Buse soil and rapid or very rapid in the Sioux soil. Available water capacity is high in the Buse soil and low in the Sioux soil. Organic matter content is moderately low or moderate in both soils. Surface runoff is medium on the Sioux soil and rapid on the Buse soil.

These soils are generally unsuited to cultivated crops because of the hazard of water erosion and the slope.

The land capability classification of the Buse soil is IVe, and that of the Sioux soil is VIs.

918D—Buse-Vienna complex, 12 to 18 percent slopes. These moderately steep, well drained soils are on convex side slopes and at the head of drainageways on moraines. The Buse soil is on the steepest, upper parts of the side slopes, and the Vienna soil is on the less sloping parts. Individual areas are 50 to 100 feet long and range from 3 to 20 acres in size. They are about 60 percent Buse soil and 30 percent Vienna soil. The two soils occur as areas so intricately mixed that separating them in mapping was not practical.

Typically, the Buse soil has a surface layer of very dark gray loam about 9 inches thick. The subsoil is dark yellowish brown loam about 15 inches thick. The

underlying material to a depth of about 60 inches is yellowish brown clay loam. In some areas the soil has many dark brown worm casts and root channels in the upper part.

Typically, the Vienna soil has a surface layer of black silty clay loam about 9 inches thick. The subsoil is about 17 inches thick. It is dark brown silty clay loam in the upper part, dark yellowish brown clay loam in the next part, and yellowish brown clay loam in the lower part. The underlying material to a depth of about 60 inches also is yellowish brown clay loam.

Included with these soils in mapping are areas of the more sloping Buse soils. Also included are small areas of the moderately well drained Lismore and somewhat poorly drained Hidewood soils in narrow drainageways and the moderately well drained Terril soils on foot slopes. Included soils make up about 10 percent of the unit.

Permeability is moderately slow in the Buse soil. It is moderate in the upper part of the Vienna soil and moderately slow in the lower part. Available water capacity is high in both soils. The content of organic matter is moderate or high in the Vienna soil and moderately low or moderate in the Buse soil. Surface runoff is rapid on both soils.

These soils are poorly suited to most of the crops commonly grown in the county. Water erosion is the main hazard. It can be controlled by contour stripcropping, spring tillage, and conservation tillage. If stripcropping is not practical, erosion can be controlled by including hay or pasture crops in the cropping sequence. Grassed waterways are needed where runoff flows across cropped areas. Heavy applications of manure increase productivity and improve tilth in eroded areas.

The land capability classification is IVe.

920C2—Storden-Clarion-Arvilla complex, 6 to 15 percent slopes, eroded. These rolling and hilly soils are on convex side slopes and hilltops on moraines. The well drained Storden soil is on the steeper, more convex parts of side slopes. The well drained Clarion soil is on the less sloping side slopes. The somewhat excessively drained Arvilla soil is on gravelly knolls and ridges. Erosion has exposed the subsoil in places. Individual areas are irregular in shape and range from 3 to 30 acres in size. They are about 40 percent Storden soil, 30 percent Clarion soil, and 20 percent Arvilla soil. The three soils occur as areas so intricately mixed that separating them in mapping was not practical.

Typically, the Storden soil has a surface layer of dark grayish brown loam about 7 inches thick. The underlying material to a depth of about 60 inches is olive brown and light olive brown loam. In places part or all of the surface layer has no free lime.

Typically, the Clarion soil has a surface layer of very dark grayish brown loam about 8 inches thick. The subsoil is brown loam about 11 inches thick. The underlying material to a depth of about 60 inches is yellowish brown loam. In some areas the soil has no free lime. In other areas the surface layer is lighter colored.

Typically, the Arvilla soil has a surface layer of very dark gray sandy loam about 8 inches thick. The subsoil is dark brown sandy loam about 8 inches thick. The underlying material to a depth of about 60 inches is pale brown and yellowish brown gravelly coarse sand.

Included with these soils in mapping are small areas of Sioux and Terril soils. The excessively drained Sioux soils are on knolls and the crest of hills where gravelly material is exposed. The moderately well drained Terril soils are on foot slopes and in drainageways. They have a thick, dark surface layer. Included soils make up about 10 percent of the map unit.

Permeability is moderate in the Storden and Clarion soils. It is moderately rapid in the upper part of the Arvilla soil and rapid or very rapid in the underlying material. Available water capacity is high in the Storden and Clarion soils and low in the Arvilla soil. The content of organic matter is low in the Storden soil, moderately low or moderate in the Clarion soil, and moderately low in the Arvilla soil. Surface runoff is medium on all three soils.

These soils are poorly suited to most of the crops commonly grown in the county. Water erosion is the main hazard. Droughtiness is a limitation in the Arvilla soil. In some areas tilth is poor because of the loss of organic matter through erosion. Spring tillage, heavy applications of manure, and the incorporation of crop residue into the soil help to control erosion, improve tilth, and conserve moisture. Grassed waterways are needed where runoff flows across cropped areas.

The land capability classification of the Storden soil is IVe, and that of the Clarion and Arvilla soils is IIIe.

921C2—Clarion-Storden loams, 6 to 12 percent slopes, eroded. These rolling, well drained soils are on convex side slopes on moraines. The Clarion soil is on the less sloping parts of the side slopes, and the Storden soil is on the steepest parts. Erosion has exposed the subsoil in places. Individual areas are about 75 to 150 feet long and range from 3 to 100 acres in size. They are about 45 percent Clarion soil and 40 percent Storden soil. The two soils occur as

areas so intricately mixed that separating them in mapping was not practical.

Typically, the Clarion soil has a surface layer of very dark grayish brown loam about 8 inches thick. The subsoil is brown loam about 11 inches thick. The underlying material to a depth of about 60 inches is yellowish brown loam. In some areas the soil has no free lime. In other areas the surface layer is lighter colored.

Typically, the Storden soil has a surface layer of dark grayish brown loam about 7 inches thick. The underlying material to a depth of about 60 inches is olive brown and light olive brown loam. In places part or all of the surface layer has no free lime.

Included with these soils in mapping are small areas of the moderately well drained Nicollet soils, the poorly drained Webster soils, and the moderately well drained Terril soils. Nicollet soils are on concave side slopes and hilltops. Webster soils are in drainageways. Terril soils are on foot slopes. Also included are small areas of soils that have stratified fine sand and silt loam in the underlying material. Included soils make up about 15 percent of the unit.

Permeability is moderate in the Clarion and Storden soils. Available water capacity is high. The content of organic matter is moderately low or moderate in the Clarion soil and low in the Storden soil. Surface runoff is medium on both soils.

These soils are used mainly for cultivated crops. They are fairly well suited to most of the crops commonly grown in the county. Water erosion is the main hazard. It can be controlled by terraces and contour stripcropping. In some areas the slopes are too irregular for terracing and for farming on the contour. Including small grain and hay crops in the cropping sequence helps to control runoff in these areas. Grassed waterways are needed in areas where runoff collects and flows across these soils. In some areas tilth is poor because of the loss of organic matter through erosion. Including green manure or sod crops in the cropping sequence improves soil structure and tilth. A protective cover of crop residue, heavy applications of manure, and conservation tillage help to control erosion and runoff and increase the rate of water infiltration.

The land capability classification is IIIe.

960D2—Storden-Clarion loams, 12 to 18 percent slopes, eroded. These moderately steep, well drained soils are on convex hilltops, on side slopes, and at the head of drainageways on moraines. The Storden soil is on the steepest parts of the side slopes, and the Clarion soil is on the less sloping parts. Erosion has exposed the subsoil in places. Individual areas are about 100 to 200 feet long and range from 3 to 25 acres in size. They are about 50 percent Storden soil and 40 percent Clarion soil. The two soils occur as areas so intricately mixed that separating them in mapping was not practical.

Typically, the Storden soil has a surface layer of dark grayish brown loam about 8 inches thick. The underlying material to a depth of about 60 inches is olive brown, yellowish brown, and light olive brown loam. In places part or all of the surface layer has no free lime.

Typically, the Clarion soil has a surface layer of very dark grayish brown loam about 8 inches thick. The subsoil is brown loam about 11 inches thick. The underlying material to a depth of about 60 inches is yellowish brown loam.

Included with these soils in mapping are small areas of the poorly drained Canisteo, Lamoure, and Webster soils in drainageways that dissect the landscape. Also included are the moderately well drained Terril soils on the concave parts of foot slopes and in shallow drainageways. Included soils make up about 10 percent of the unit.

Permeability is moderate in the Storden and Clarion soils. Available water capacity is high. The content of organic matter is low in the Storden soil and moderately low or moderate in the Clarion soil. Surface runoff is rapid on both soils.

These soils are suited to most of the crops commonly grown in the county. Water erosion is the main hazard. In some areas tilth is poor because of the loss of organic matter through erosion. Contour stripcropping, spring tillage, and conservation tillage help to control erosion. If stripcropping is not practical, erosion can be controlled by including hay or pasture crops in the cropping sequence. Grassed waterways are needed where runoff flows across cropped areas. Heavy applications of manure increase productivity and improve tilth in eroded areas.

The land capability classification is IVe.

964C2—Vienna-Buse complex, 6 to 12 percent slopes, eroded. These rolling, well drained soils are on convex side slopes on moraines. The Buse soil is on the steepest parts of the side slopes, and the Vienna soil is on the less sloping parts. Erosion has exposed the subsoil in places. Individual areas are about 75 to 150 feet long and range from 3 to 80 acres in size. They are about 50 percent Vienna soil and 40 percent

Buse soil. The two soils occur as areas so intricately mixed that separating them in mapping was not practical.

Typically, the Vienna soil has a surface layer of very dark grayish brown silty clay loam about 6 inches thick. The subsoil is clay loam about 18 inches thick. It is dark brown in the upper part, dark yellowish brown in the next part, and yellowish brown in the lower part. The underlying material to a depth of about 60 inches is yellowish brown and pale brown clay loam.

Typically, the Buse soil has a surface layer of very dark grayish brown loam about 7 inches thick. The subsoil is dark yellowish brown loam about 15 inches thick. The underlying material to a depth of about 60 inches is yellowish brown and light olive brown clay loam. In some areas the soil has many dark brown worm casts and root channels in the upper part.

Included with these soils in mapping are small areas of the more sloping Buse and less sloping Vienna soils. Also included are small areas of the moderately well drained Lismore and somewhat poorly drained Hidewood soils in narrow drainageways and the moderately well drained Terril soils on foot slopes. Included soils make up about 10 percent of the unit.

Permeability is moderate in the upper part of the Vienna soil and moderately slow in the lower part. It is moderately slow in the Buse soil. Available water capacity is high in both soils. The content of organic matter is moderate in the Vienna soil and moderately low in the Buse soil. Surface runoff is medium on both soils.

This soil is used mainly for cultivated crops. It is fairly well suited to most of the crops commonly grown in the county. Water erosion is the main hazard. It can be controlled by terraces and contour farming. In some areas, however, the slopes are too irregular for terracing or farming on the contour. In these areas including small grain and hay crops in the cropping sequence helps to control runoff and erosion. Grassed waterways are needed in areas where runoff collects and flows across these soils. Heavy applications of manure, a winter cover crop, and a system of conservation tillage that leaves the surface rough help to control erosion. Including green manure or sod crops in the cropping sequence improves soil structure and tilth.

The land capability classification of the Buse soil is IIIe, and that of the Vienna soil is IVe.

1030—Pits, gravel-Udorthents complex. This map unit is in areas that are or formerly were mined for sand and gravel. It consists of excavations, stockpiles of sand and gravel, and some areas filled with waste and water. Individual areas range from about 3 to 100 acres in size and are irregular in shape. Included in this unit are borrow pits from which loamy material has been removed.

Some areas have been reclaimed. Reclamation generally includes extensive filling and grading. Some areas where the topsoil was stockpiled can be reclaimed for agricultural uses. The pits are suitable for the disposal of refuse that will not cause ground water pollution. Some reclaimed areas are used for commercial, industrial, or residential development. Wildlife habitat or recreational areas can be developed if vegetation is established and if the existing ponds are used (fig. 9). Onsite investigation is needed to determine the potentials and limitations of individual areas for proposed uses.

This map unit is not assigned a land capability classification.

1051—Glencoe silty clay loam, ponded. This level, very poorly drained soil is in marshes, undrained depressions, and undrained lakebeds on moraines. It is subject to ponding and rare flooding unless there is an extended droughty period. Individual areas are oval or irregular in shape and range from 3 to several hundred acres in size.

Typically, the surface layer is black silty clay loam about 9 inches thick. The subsurface layer is silty clay loam about 24 inches thick. It is black in the upper part and very dark gray and mottled in the lower part. The subsoil is olive gray, mottled clay loam about 13 inches thick. The underlying material to a depth of about 60 inches is olive, mottled clay loam. In a few areas the soil is overlain by a layer of muck about 6 inches thick.

Included with this soil in mapping are small areas where the underlying material is sand or gravelly sand. Also included are soils that have a high content of calcium carbonate. Included soils make up about 10 to 15 percent of the unit.

Permeability is moderate or moderately slow in the Glencoe soil. Available water capacity is high. The content of organic matter is very high. Surface runoff is slow to ponded. The seasonal high water table is 3 feet above to 1 foot below the surface.

This soil generally is unsuited to crops and pasture because of continuous ponding. In most areas it is well suited to wetland wildlife habitat.

The land capability classification is VIIIw.

1824—Quam silty clay loam, ponded. This level, very poorly drained soil is in marshes, undrained

Figure 9.—Trees, shrubs, and grasses in an area of Pits, gravel-Udorthents complex. The vegetation provides food and cover for wildlife.

depressions, and undrained lakebeds on moraines. It is subject to ponding unless there is an extended droughty period. Individual areas are irregularly shaped or oval and range from 3 to several hundred acres in size.

Typically, the surface layer is black silty clay loam about 10 inches thick. The subsurface layer also is black silty clay loam. It is about 47 inches thick. The underlying material to a depth of about 60 inches is olive gray, mottled silty clay loam. In some large depressions the soil is overlain by a layer of muck as much as 15 inches thick. In places the surface layer is decomposed organic material about 6 inches thick.

Included with this soil in mapping are small areas of soils that have a high content of calcium carbonate. These soils are in landscape positions similar to those of the Quam soil. Also included are small areas of soils that are underlain by sand or gravelly sand. Included soils make up 10 to 15 percent of the unit.

Permeability is moderately slow in the Quam soil. Available water capacity is high. The content of organic

matter is very high. Surface runoff is slow to ponded. The seasonal high water table is 2 feet above to 1 foot below the surface.

This soil generally is unsuited to crops and pasture because of continuous ponding. In most areas it is well suited to wetland wildlife habitat.

The land capability classification is VIIIw.

This page intentionally left blank.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban and built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

About 394,000 acres in the survey area, or nearly 86 percent of the total acreage, meets the soil requirements for prime farmland. Scattered areas of this land are throughout the county. Most of the prime farmland is used for crops. The crops grown on this land, mainly corn and soybeans, account for most of the county's total agricultural income each year.

A recent trend in land use in some parts of the county has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in the survey area that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Some soils that have a seasonal high water table qualify for prime farmland only in areas where this limitation has been overcome by drainage measures. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not this limitation has been overcome by corrective measures.

This page intentionally left blank.

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock or wetness can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

The soils in this survey area are assigned to interpretive groups at the end of each map unit description and in tables 5 and 6. The groups for each map unit also are shown in the section "Interpretive Groups," which follows the tables at the back of this survey.

This publication includes suggested management practices that are intended to increase crop production, reduce the hazards of soil blowing and water erosion, and reduce wetness. Over a period of time, some or all of these conservation practices may or may not be in accordance with federal, state, and local laws and with agency rules and guides.

Crops and Pasture

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

More than 417,000 acres in Murray County was used for crops and pasture in 1980. Of this total, 320,000 acres was used for corn, soybeans, and other row crops; 40,000 acres for small grain, mainly oats and wheat; 22,000 acres for hay; and 35,000 acres for permanent pasture *(13)*. The acreage used for field crops may fluctuate from year to year because of anticipated market prices, weather conditions, and the wide diversity of crops suited to the soils.

The field crops and kinds of small grain suited to the soils and climate in the county include many that are not now commonly grown. Grain sorghum, sunflowers, dry beans, and sugar beets are examples of crops that can be grown if economic conditions are favorable. Rye, barley, flax, and buckwheat also can be grown. Seed can be harvested from several cool- and warm-season

grasses, including bromegrass, big bluestem, switchgrass, and indiangrass. Seed also can be harvested from sweet clover and red clover.

The specialty crops grown in the county are vegetables, small fruit, tree fruit, and nursery plants. They are grown mainly by home gardeners. Most vegetables and fruits grow well on soils that are characterized by good natural drainage, warm up early in spring, and are protected from wind damage. Supplemental water should be available. The latest information about growing specialty crops can be obtained from local offices of the Agricultural Extension Service and the Soil Conservation Service.

The potential of the soils in Murray County for increased production of food is good. Much of the farmland has a land capability classification of I or II, which indicates only slight limitations or hazards that are easily overcome. Crop production could generally be increased by applying sound soil and water conservation practices and the latest crop production technology to all of the cropland in the county. This soil survey can greatly facilitate the application of such technology.

The main concerns in managing the soils in Murray County for crops and pasture are controlling water erosion and soil blowing, improving drainage, and maintaining fertility and tilth. On approximately 181,600 acres in the county, soil loss from soil blowing and water erosion exceeds tolerable limits as measured by the Universal Soil Loss Equation. This equation is the maximum rate of annual soil loss, in tons per acre, that will permit crop productivity to be sustained economically over a long period. The following paragraphs describe the concerns in managing the cropland and pasture in Murray County.

Water erosion is a major hazard on about half the cropland in the county. In 1982, soil loss from water erosion averaged 2.8 tons per acre. Erosion is generally a hazard on soils having a slope of more than 3 percent, especially on the undulating or steeper soils.

Water erosion is damaging for two reasons. First, the productivity of the soil is reduced as plant nutrients, organic matter, and the surface layer are lost and part of the subsoil is incorporated into the plow layer. Second, water erosion on farmland results in the sedimentation of rivers and streams. Control of water erosion minimizes this pollution and improves the quality of water for recreational uses and for fish and wildlife.

Erosion-control measures, such as crop rotations that include grasses and legumes, contour farming, stripcropping, conservation tillage, and terraces, provide a protective surface cover, reduce the runoff rate, shorten long slopes, and increase the rate of water infiltration. A cropping system that includes close-sown crops, such as small grain and meadow crops, can hold soil losses to levels that will not reduce the productive capacity of the soils. Contour farming and contour stripcropping are best suited to soils that have uniform slopes ranging from 2 to 12 percent. In areas of soils on short and irregular slopes, farming on the contour and terracing may be difficult. In some areas of these soils, cut-and-fill terraces and water- and sediment-control basins can be used.

Systems of conservation tillage that leave crop residue on the surface, such as no-till, mulch-till, and ridge-till systems, can be applied on most of the soils in the county. No-till systems can be applied on well drained and excessively drained, steeply sloping soils.

Terraces intercept concentrated runoff and help to prevent the formation of gullies. Terraces and diversions reduce the length of the slopes. They are effective on deep, well drained soils that have uniform slopes, such as Collinwood, Everly, Poinsett, and Vienna soils. Most of the other soils in the county are less well suited to terraces and diversions because of irregular or steep slopes; poor drainage, which results in excessive wetness in the terrace channels; a sandy subsoil, which would be exposed in the terrace channels; or sand and gravel within a depth of 40 inches.

The nearly level soils in the county also may be susceptible to water erosion. Rills or gullies can form where field drainage systems enter county road ditches and drainage mains. Erosion-control structures and surface water inlets are needed in these areas.

In 1982, soil loss from soil blowing averaged 3.1 tons per acre in Murray County. The factors responsible for a susceptibility to soil blowing include the texture and structure of the surface layer, the presence of free carbonates at the surface, surface roughness, field size, and vegetative cover. Soil blowing is a hazard on soils that have a surface layer of sandy loam or of fine textured material and on soils that have free carbonates at the surface. The carbonates reduce the stability of soil aggregates. Management has little effect on soil texture or the presence of free carbonates. The best means of controlling soil blowing is through proper management of surface roughness, field size, and the vegetative cover.

Surface roughness can be created by some types of tillage. Moldboard plowing in the fall may temporarily help to control soil blowing by leaving the surface cloddy, but the cloddiness may be destroyed by

freezing or thawing. Using a chisel plow instead of a moldboard plow creates a more stable, better defined pattern of ridges and valleys and mixes crop residue with the soil or leaves it on the surface. Maintaining a rough surface on ridges oriented perpendicular to the wind may reduce soil blowing by as much as 50 percent.

In large open fields wind speeds reach maximum levels. Establishing stable vegetative borders around the fields can reduce the susceptibility to soil blowing. Planting field windbreaks or other vegetative barriers and wind stripcropping also can help to control soil blowing.

Managing crop residue can be one of the most cost effective methods of controlling soil blowing. Standing residue is the most effective, but tillage methods that leave part or all of the crop residue on the surface during periods when the soil is highly susceptible to soil blowing also are very effective. Residue management can be accomplished if the primary tillage is performed by a chisel plow, disk, or field cultivator that incorporates some of the residue into the soil. This tillage method leaves the surface rough and exposes some of the soil. The exposed soil can warm up and dry out in the spring, thus allowing timely secondary tillage and planting.

A system of conservation tillage leaves large amounts of crop residue on the surface. Generally, at least 30 percent of the surface is covered with residue after planting. Forms of conservation tillage include mulch-till, strip-till, ridge-till, and no-till. Several factors should be considered when a system of conservation tillage is selected. These include soil texture, drainage, field slope, and the crop being grown. Tillage methods that leave small amounts of crop residue on the surface and ridge-till systems in row cropped areas are suitable on somewhat poorly drained soils and on wetter soils, whereas systems that leave large amounts of crop residue on the surface, including strip-till and no-till, are better suited to moderately well drained to excessively drained soils.

Wetness is the major management concern on approximately one-third of the cropland in the county. The poorly drained and very poorly drained soils may be too wet for crop production unless they are drained. A drainage system also may be needed in the wet areas in drainageways and swales that are included with the somewhat poorly drained and moderately well drained soils in mapping.

The design of both surface and subsurface drainage systems varies with the natural drainage, permeability, and texture of the soil. A combination of surface and subsurface drains is needed in most of the poorly drained and very poorly drained soils in the county. The spacing of subsurface drainage lines depends on the soil type and the depth at which the drains can be installed. The lines should be more closely spaced in slowly permeable soils than in the more permeable soils. Suitable outlets are needed for any type of drainage system. In some areas they are not readily available.

Ponding usually occurs on Glencoe, Knoke, Lura, Oldham, Quam, and Rolfe soils because of the runoff from adjacent areas. Open field ditches may be needed to remove this excess surface water. When surface water enters large ditches, gullies can form on the ditchbanks. The surface water from surface drainage systems and ponded areas can be lowered safely into ditches through drop pipes or a concrete box structure. The ponded Glencoe and Quam soils are generally unsuited to cultivated crops because of continuous ponding. Drainage is difficult or not feasible because of a lack of suitable drainage outlets.

Soybeans grown on poorly drained and very poorly drained, calcareous soils commonly are subject to chlorosis, which results from a lack of available iron. This limitation can be overcome by installing a drainage system and by growing varieties of soybeans that can tolerate a high content of lime.

Information about the design of drainage systems for each kind of soil is available at local offices of the Soil Conservation Service and in a Minnesota drainage guide *(14)*.

Soil tilth refers to the physical condition of the soil. Soils with good tilth are granular and porous. Tilth affects seed germination and emergence, the uptake of nutrients by plants, and the infiltration of water into the soil. Soils with poor tilth have large clods and a compacted surface layer and subsurface layer. Poor tilth can considerably lower crop yields.

Intensive cultivation, especially when the soils are wet, results in deterioration of tilth and leaves the soil very cloddy when dry. It also can result in compaction. This condition is a serious management concern on moderately fine textured and fine textured, poorly drained or very poorly drained soils. Tilth is poor in areas of eroded soils because of the loss of organic matter through erosion. Crop rotations that produce a small amount of crop residue result in deterioration of tilth because only a small amount of organic matter is returned to the soil. Incorporation of crop residue into the soil, applications of livestock manure or other organic waste, crop rotations that include grasses and legumes, green manure and cover crops, minimum

tillage, and surface and subsurface drainage systems improve tilth and prevent excessive compaction.

Natural fertility varies among the soils in Murray County. It is naturally medium or high in most soils but is low in the sandy and eroded soils. Nearly all of the soils are neutral or alkaline, but Rolfe soils are medium acid or slightly acid. Applications of ground limestone may be needed on the Rolfe soils to raise the pH to a level sufficient for the good production of legumes and other crops that grow well only on nearly neutral soils.

The response of crops to applications of commercial fertilizer is good on most soils. If excessive wetness or droughtiness is a limitation, the response is not so pronounced and the measures intended to improve fertility are not cost effective unless the limitation is overcome. Most of the soils in the county are especially low in content of phosphorus but have ample amounts of lime. The need for fertilizer and the amount needed depend on the kind of soil, the past and present cropping system and level of management, the kind of crop that is to be grown, and the level of expected yields. Soil tests provide guidelines for choosing the proper kinds and amounts of fertilizer.

Several soils in the county have free carbonates in the surface layer. The free carbonates tie up plant nutrients and limit their availability. These soils may have micronutrient deficiencies of manganese, zinc, and boron. Applications of commercial fertilizer that has a high content of phosphorus and potash help to ensure that the supply of plant nutrients is adequate and minimize the adverse effects of the high content of lime.

Organic matter content ranges from very low to very high in the soils of Murray County. It can be increased or maintained by returning crop residue to the soil, applying livestock manure or other organic waste, including grasses and legumes in the cropping sequence, or plowing cover crops under.

The acreage in Murray County used for permanent pasture has been decreasing in recent years. The permanent pasture is mainly in areas of rolling and hilly soils that are subject to erosion, wet soils that cannot be used for row crops because they are not adequately drained, or droughty soils. Proper stocking rates, pasture rotation, applications of fertilizer, weed control, and restricted grazing during wet periods help to keep the pasture in good condition. A drainage system is needed on the poorly drained and very poorly drained soils. In places the pasture could be renovated by reseeding to more productive species. Species selection should be based on the soil type and drainage condition. Measures that control erosion are particularly important when the pasture is seeded.

A proper seeding mixture increases the productivity of permanent pasture. Well drained to somewhat poorly drained soils, such as Barnes, Buse, Clarion, Nicollet, Everly, Wilmonton, Collinwood, and Vienna soils, are suited to the widest range of forage species. These include cool-season species, such as alfalfa, birdsfoot trefoil, red clover, smooth brome, timothy, orchardgrass, Kentucky bluegrass, and reed canarygrass. Warm-season species, such as big bluestem, indiangrass, and switchgrass, grow well during July and August on these soils. All of the grasses grow well on the somewhat poorly drained and poorly drained Waldorf, Marysland, Lamoure, and Webster soils.

The poorly drained and very poorly drained Lamoure and Marysland soils are suited only to those species that can withstand wet conditions. These include reed canarygrass, creeping foxtail, redtop, birdsfoot trefoil, alsike clover, and ladino clover. If these soils are drained, timothy, smooth bromegrass, Kentucky bluegrass, and red clover can be grown.

Moderately well drained to excessively drained soils, such as Arvilla, Egeland, and Sverdrup soils, usually produce forage in the spring and early summer and again in the fall, when the amount of precipitation is adequate. Droughty conditions limit production during the summer. Alfalfa, red clover, birdsfoot trefoil, smooth brome, orchardgrass, timothy, Kentucky bluegrass, and intermediate wheatgrass grow well when adequate moisture supplies are available. Warm-season grasses, including big bluestem, little bluestem, indiangrass, switchgrass, and sideoats grama, also grow well on the well drained to excessively drained soils. These species provide good forage during the summer. If used with cool-season species, they can help to provide a full season of forage. Current information about variety selection and species adaptation can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension

agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w*, *s*, or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Detailed Soil Map Units" and in the yields table.

Windbreaks and Environmental Plantings

Since the days of the early settlers, windbreaks have been planted to protect farmsteads and livestock. In the 1930's, they were planted to control soil blowing. In recent years field windbreaks have been planted to trap snow and thus increase the moisture supply. Maximum growth and survival rates can be obtained by controlling weeds around seedlings.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 7 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 7 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a commercial nursery.

The paragraphs that follow describe the different windbreak suitability groups to which the soils in the county have been assigned. The groups for each map unit are shown in the section "Interpretive Groups," which follows the tables at the back of this survey. In areas of soils that are subject to severe water erosion, site preparation should be limited to spot treatment, extending no more than 2 feet from where the plant is established.

Windbreak suitability group 1.—This group consists dominantly of somewhat poorly drained and moderately well drained soils that have a moderately high water table. Permeability is moderate or moderately slow. The soils generally do not have free carbonates in the upper part.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on these soils. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 1K.—This group consists dominantly of somewhat poorly drained and moderately well drained soils that have a moderately high water table. Permeability is moderate or moderately slow. The soils generally have free carbonates in the upper part.

The trees and shrubs grown as windbreaks and environmental plantings on these soils should be those that are tolerant of a high content of lime. The free carbonates in the soils tie up plant nutrients and limit their availability. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 2.—This group consists dominantly of poorly drained soils that have a high water table. These soils have been artificially drained. The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of wetness. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 2K.—This group consists dominantly of poorly drained soils that have a high water table. These soils have been artificially drained. They generally have free carbonates in the upper part.

The trees and shrubs grown as windbreaks and environmental plantings on these soils should be those that are tolerant of a high content of lime and wetness. The free carbonates tie up plant nutrients and limit their availability. Because of the wetness, seedling mortality is moderate and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 2W.—This group consists dominantly of very poorly drained, depressional soils that are subject to ponding. These soils have been artificially drained. The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of extreme wetness. Because of the wetness, seedling mortality is severe and spring planting may be delayed. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 3.—This group consists dominantly of well drained and moderately well drained, loamy and silty soils. Permeability is moderate or moderately slow. The soils generally do not have free carbonates in the upper part.

A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on these soils. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 4C.—This group consists dominantly of moderately well drained soils that have a clayey surface layer and are slowly permeable. The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of droughty conditions. Seedling mortality is severe because the high content of clay causes moisture stress. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 5.—This group consists dominantly of well drained soils that have a moderate available water capacity. A wide variety of trees and shrubs can be grown as windbreaks and environmental plantings on these soils. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 6G.—This group consists dominantly of excessively drained to moderately well drained soils that have sand or sand and gravel at a depth of 20 to 40 inches. The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of droughty conditions. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 7.—This group consists dominantly of somewhat excessively drained soils that have a low available water capacity. The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of droughty conditions. Seedling mortality is moderate because of the moisture stress caused by droughtiness. Leaving some vegetation on the surface during the early years of establishment helps to control soil blowing. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 8.—This group consists dominantly of excessively drained and well drained, loamy soils that have free carbonates. The trees and shrubs grown as windbreaks and environmental plantings should be those that are tolerant of a high content of lime. The free carbonates tie up plant nutrients and limit their availability. Cultivation or applications of herbicide help to remove competing vegetation.

Windbreak suitability group 10.—This group consists dominantly of soils or miscellaneous areas that generally are not suitable for windbreaks. Wetness, slope, a restricted available water capacity, or a combination of these limits the planting, survival, or growth of trees or shrubs. Onsite investigation may identify areas where trees and shrubs can be planted. Special management is needed in these areas.

Recreation

The major recreational areas in the county are Lake Shetek State Park; county parks on the shores of Current Lake, Fulda Lake, Lake Sarah, and Lime Lake; and about 6,000 acres of state wildlife management areas, which are open to the public for hunting and other recreational activities. All of the towns have community parks. The potential for the development of other recreational areas is fair. Areas along the shoreline of some of the lakes and wooded areas along some of the streams can be further developed into parks and other recreational areas.

The soils of the survey area are rated in table 8 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 8, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils are gently sloping and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding

during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

Wildlife Habitat

The soils in Murray County provide good habitat for various species of wildlife. Changes in land use have affected the population of many wildlife species. Intensive farming, for example, has severely reduced the population of pheasants. Other small game in the county are Hungarian partridge, rabbit, squirrel, raccoon, and fox.

Murray County is on the migration route of ducks and geese. The population of ducks is highest near permanent marshes and the many small lakes in the county. It also is high near some of the 350 ponds and pits that have been constructed throughout the county. Most of the marshes are state owned and are part of the 47 wildlife management areas in the county.

The wooded areas around Lake Shetek and along streams have a high population of white-tailed deer. Walleye, northern pike, and panfish are in Lake Shetek, Lake Sarah, and some of the other lakes in the county. Bullheads are common in many of the 15 lakes in the county, but most of the lakes are too shallow to support game fish.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 9, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and soybeans.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface

layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, wheatgrass, and grama.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, hackberry, ash, crabapple, cottonwood, basswood, and chokecherry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian olive, autumn olive, and crabapple.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, barnyardgrass, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include Hungarian partridge, pheasant, meadowlark, mourning dove, field sparrow, cottontail, badger, skunk, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include thrushes, woodpeckers, squirrels, owls, raccoon, and deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock or a very firm dense layer, stone content, soil texture, and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and *small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, and the available water capacity in the upper 40 inches affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 11 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the

limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope and bedrock can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, and soil reaction affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock or the water table to permit revegetation. The soil material used as final cover for a

landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. These soils may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, and bedrock.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an

appreciable amount of gravel or stones, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel or stones, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders or of organic matter. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

This page intentionally left blank.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

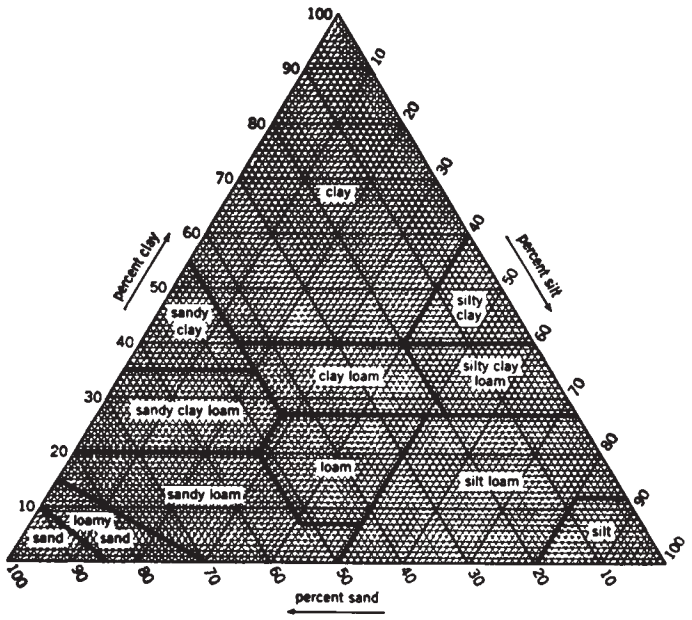


Figure 10.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Engineering Index Properties

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 10). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system *(2)* and the system adopted by the American Association of State Highway and Transportation Officials *(1)*.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and

clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at ⅓ bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Coarse sands, sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can easily be grown.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can easily be grown.

8. Soils that are not subject to soil blowing because of coarse fragments on the surface or because of surface wetness.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 15, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups in table 16, the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary inundation of an area, is caused by overflowing streams or by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced

electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

This page intentionally left blank.

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(12)*. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 17 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Boroll (*Bor*, meaning cool, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haploborolls (*Hapl*, meaning minimal horizonation, plus *boroll*, the suborder of the Mollisols that is cool).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Udic* identifies the subgroup that is humid. An example is Udic Haploborolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is sandy, mixed Udic Haploborolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the underlying material can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual (11)*. Many of the technical terms used in the descriptions are defined in *Soil Taxonomy (12)*. Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Arvilla Series

The Arvilla series consists of somewhat excessively drained soils on stream terraces, outwash plains, and glacial moraines. These soils formed in a mantle of loamy glacial outwash, which is underlain by sandy and gravelly outwash. Permeability is moderately rapid in the upper part of the profile and rapid or very rapid in the lower part. Slopes range from 0 to 15 percent.

Typical pedon of Arvilla sandy loam, 2 to 6 percent slopes, 2,200 feet west and 300 feet south of the northeast corner of sec. 2, T. 108 N., R. 41 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) sandy loam, very dark grayish brown (10YR 3/2) dry; weak and moderate very fine and fine subangular blocky structure; friable; about 3 percent coarse fragments; neutral; abrupt smooth boundary.

Bw1—8 to 14 inches; dark brown (10YR 3/3) sandy loam, brown (10YR 5/3) dry; weak coarse prismatic structure parting to weak medium subangular blocky; very friable; about 5 percent coarse fragments; mildly alkaline; clear smooth boundary.

Bw2—14 to 19 inches; brown (10YR 4/3) coarse sandy loam; weak coarse subangular blocky structure; very friable; about 13 percent coarse fragments; mildly alkaline; clear wavy boundary.

2C—19 to 60 inches; light yellowish brown (10YR 6/4) and pale brown (10YR 6/3) gravelly coarse sand; single grain; loose; about 20 percent coarse fragments; strong effervescence; moderately alkaline.

The mollic epipedon is 7 to 10 inches thick. The thickness of the solum ranges from 14 to 22 inches. The content of coarse fragments ranges, by volume, from 2 to 15 percent in the solum and from 15 to 30 percent in the 2C horizon. These fragments are dominantly 2 to 30 millimeters in diameter.

The A horizon has value of 3 or 4. The Bw horizon has hue of 2.5Y to 7.5YR and chroma of 1 to 3. It is sandy loam, loam, or coarse sandy loam. In the upper part of the 2C horizon, lime accumulations occur as coatings on the bottom of pebbles or have been dispersed throughout the horizon.

Barnes Series

The Barnes series consists of well drained, moderately permeable soils on moraines. These soils formed in loamy glacial till. Slopes range from 2 to 18 percent.

Typical pedon of Barnes loam, 2 to 4 percent slopes, 1,600 feet north and 95 feet west of the southeast corner of sec. 22, T. 108 N., R. 43 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine and medium granular structure; friable; about 2 percent coarse fragments; neutral; abrupt smooth boundary.

Bw—9 to 17 inches; dark brown (10YR 4/3) loam; weak medium and coarse prismatic structure parting to moderate fine and medium subangular blocky; friable; about 3 percent coarse fragments; neutral; gradual wavy boundary.

Bk—17 to 34 inches; dark yellowish brown (10YR 4/4) loam; moderate fine and medium subangular blocky structure; friable; many lime masses; few small iron and manganese oxide masses; about 5 percent coarse fragments; violent effervescence; moderately alkaline; gradual wavy boundary.

C—34 to 60 inches; olive brown (2.5Y 4/4) loam; few medium distinct light brownish gray (2.5Y 6/2) mottles; massive; friable; few lime masses; few iron and manganese oxide masses; about 8 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 12 to 36 inches. The depth to free lime ranges from 12 to 23 inches. The thickness of the mollic epipedon ranges from 7 to 16 inches. The content of coarse fragments ranges, by volume, from 2 to 10 percent throughout the profile. These fragments are dominantly 2 to 25 millimeters in diameter.

The A horizon has value of 2 or 3. It is loam, sandy loam, or clay loam. The B horizon has value of 3 to 5 and chroma of 2 to 4. The C horizon has value of 4 or 5 and chroma of 2 to 4.

Biscay Series

The Biscay series consists of poorly drained soils on outwash plains, on moraines, and in overflow channels. These soils formed in 20 to 40 inches of loamy sediments, which are underlain by sand and gravel. Permeability is moderate in the upper part of the profile and rapid in the lower part. Slopes are 0 to 2 percent.

Typical pedon of Biscay loam, 2,200 feet west and 100 feet south of the northeast corner of sec. 34, T. 106 N., R. 39 W.

Ap—0 to 10 inches; black (N 2/0) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

A—10 to 16 inches; black (10YR 2/1) loam, very dark

gray (10YR 3/1) dry; moderate fine and medium subangular blocky structure; friable; neutral; gradual wavy boundary.

AB—16 to 22 inches; very dark gray (10YR 3/1) loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure; friable; few olive gray (5Y 5/2) worm casts; neutral; clear wavy boundary.

Bg1—22 to 30 inches; olive gray (5Y 5/2) loam; common fine distinct dark grayish brown (2.5Y 4/2) and olive brown (2.5Y 4/4) mottles; weak fine subangular blocky structure; friable; about 3 percent coarse fragments; neutral; clear wavy boundary.

Bg2—30 to 38 inches; olive (5Y 4/3) gravelly loam; few medium distinct light olive gray (5Y 6/2) and few fine prominent light olive brown (2.5Y 5/6) mottles; weak fine subangular blocky structure; friable; few fine lime masses; about 15 percent gravel; slight effervescence; mildly alkaline; clear wavy boundary.

2Cg1—38 to 46 inches; olive gray (5Y 4/2) gravelly loamy sand; few medium distinct pale olive (5Y 6/4) mottles; single grain; loose; few fine lime masses; about 20 percent gravel; slight effervescence; mildly alkaline; clear smooth boundary.

2Cg2—46 to 55 inches; olive gray (5Y 5/2) loamy coarse sand; few fine distinct light gray (5Y 7/2) and few fine prominent yellowish brown (10YR 5/6) mottles; moderate fine and medium subangular blocky structure; friable; about 8 percent gravel; slight effervescence; mildly alkaline; clear smooth boundary.

2Cg3—55 to 60 inches; olive gray (5Y 5/2) gravelly coarse sand; few medium prominent yellowish brown (10YR 5/6) mottles; single grain; loose; about 25 percent gravel; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to calcareous sand and gravel range from 20 to 40 inches. The mollic epipedon ranges from 16 to 24 inches in thickness. The content of coarse fragments in the 2C horizon ranges, by volume, from 5 to 50 percent. These fragments are 2 to 20 millimeters in size.

The A horizon is neutral in hue or has hue of 10YR or 2.5Y. It has value of 2 or 3. It is typically loam, but the range includes sandy clay loam, clay loam, and silty clay loam. The Bg horizon has hue of 5Y or 2.5Y. It has few or common mottles. It is dominantly loam, sandy clay loam, or clay loam. In some pedons, however, the lower part of this horizon is gravelly loam or gravelly sandy loam. The 2C horizon has hue of 2.5Y or 5Y and chroma of 1 or 2. It is loamy coarse sand, loamy sand, coarse sand, sand, or the gravelly or very gravelly analogs of those textures.

Buse Series

The Buse series consists of well drained, moderately permeable or moderately slowly permeable soils on moraines. These soils formed in loamy glacial till. Slopes range from 3 to 40 percent.

Typical pedon of Buse loam, in an area of Buse-Barnes loams, 12 to 18 percent slopes; 800 feet north and 800 feet west of the southeast corner of sec. 29, T. 107 N., R. 41 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable; about 2 percent coarse fragments; slight effervescence; mildly alkaline; abrupt smooth boundary.

Bk—9 to 24 inches; dark yellowish brown (10YR 4/4) loam; weak fine subangular blocky structure; friable; many soft lime masses; few iron and manganese oxide stains; about 5 percent coarse fragments; violent effervescence; mildly alkaline; gradual wavy boundary.

C—24 to 60 inches; yellowish brown (10YR 5/4) loam; common fine prominent light brownish gray (2.5Y 6/2) mottles; massive; friable; few iron oxide concretions; few soft lime masses; about 8 percent coarse fragments; strong effervescence; mildly alkaline.

The mollic epipedon is 7 to 10 inches thick. Free lime is typically throughout the profile. The calcium carbonate equivalent ranges from 12 to 30 percent. The content of coarse fragments ranges, by volume, from 2 to 10 percent throughout the profile. These fragments are dominantly 2 to 25 millimeters in size.

The A horizon has value of 2 or 3 and chroma of 1 or 2. The Bk horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 5.

Canisteo Series

The Canisteo series consists of poorly drained, moderately permeable soils on moraines. These soils formed in loamy glacial material. Slopes are 0 to 2 percent.

Typical pedon of Canisteo clay loam, 800 feet west and 200 feet south of the northeast corner of sec. 30, T. 107 N., R. 40 W.

Ap—0 to 9 inches; black (N 2/0) clay loam, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure; friable; about 2 percent coarse fragments; slight effervescence; moderately alkaline; abrupt smooth boundary.

A—9 to 17 inches; black (N 2/0) clay loam, very dark gray (10YR 3/1) dry; weak very fine and fine subangular blocky structure; friable; about 2 percent coarse fragments; slight effervescence; moderately alkaline; clear smooth boundary.

ABg—17 to 23 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; few tongues of black (N 2/0) and dark grayish brown (2.5Y 4/2) material; weak very fine subangular blocky structure; friable; about 2 percent coarse fragments; slight effervescence; moderately alkaline; gradual irregular boundary.

Bg1—23 to 30 inches; dark gray (10YR 4/1) clay loam; few fine prominent olive gray (5Y 4/2) mottles; few tongues of black (10YR 2/1) material; weak fine subangular blocky structure; friable; about 5 percent coarse fragments; strong effervescence; mildly alkaline; gradual smooth boundary.

Bg2—30 to 36 inches; dark grayish brown (2.5Y 4/2) clay loam; common medium prominent olive (5Y 4/4) mottles; weak fine subangular blocky structure; friable; about 5 percent coarse fragments; strong effervescence; mildly alkaline; gradual smooth boundary.

Cg—36 to 60 inches; olive gray (5Y 5/2) clay loam; common fine prominent olive yellow (2.5Y 6/6) and few fine distinct olive (5Y 5/4) mottles; massive; friable; about 8 percent coarse fragments; violent effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 14 to 24 inches. The thickness of the solum ranges from 20 to 50 inches. The soils are calcareous throughout. The content of coarse fragments ranges, by volume, from 2 to 8 percent throughout the profile. These fragments are dominantly 2 to 20 millimeters in diameter. The solum is clay loam, loam, silt loam, or silty clay loam.

The A horizon is neutral in hue and has value of 2 or 3, or it has hue of 10YR, value of 2 or 3, and chroma of 1. The Bg horizon has hue of 10YR to 5Y and value of 4 or 5. The C horizon has hue of 2.5Y or 5Y, value of 5 or 6, and chroma of 2 to 4. It is loam or clay loam.

Clarion Series

The Clarion series consists of well drained, moderately permeable soils on till plains and moraines. These soils formed in loamy, calcareous glacial till. Slopes range from 2 to 18 percent.

Typical pedon of Clarion loam, 2 to 4 percent slopes, 800 feet north and 250 feet west of the southeast corner of sec. 30, T. 105 N., R. 39 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; about 2 percent coarse fragments; neutral; abrupt smooth boundary.

AB—8 to 12 inches; very dark grayish brown (10YR 3/2) loam, dark yellowish brown (10YR 4/4) dry; few black (10YR 2/1) coatings on faces of peds; weak fine granular and subangular blocky structure; friable; about 2 percent coarse fragments; neutral; gradual smooth boundary.

Bw—12 to 23 inches; brown (10YR 4/3) loam; weak fine subangular blocky structure; friable; about 2 percent coarse fragments; neutral; clear smooth boundary.

C1—23 to 30 inches; yellowish brown (10YR 5/4) loam; weak fine subangular blocky structure; friable; few medium lime masses; about 3 percent coarse fragments; strong effervescence; mildly alkaline; gradual smooth boundary.

C2—30 to 44 inches; yellowish brown (10YR 5/4) loam; common medium distinct gray (10YR 6/1) and common fine faint dark yellowish brown (10YR 4/4) mottles; massive; friable; common medium lime masses; few iron oxide stains on faces of peds; about 5 percent coarse fragments; strong effervescence; mildly alkaline; gradual smooth boundary.

C3—44 to 60 inches; yellowish brown (10YR 5/6) loam; many fine and medium distinct light brownish gray (10YR 6/2) and common fine prominent brown (7.5YR 4/4) mottles; massive; friable; few iron oxide stains on faces of peds; about 5 percent coarse fragments; strong effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 18 to 50 inches. The thickness of the mollic epipedon ranges from 10 to 20 inches. The content of coarse fragments ranges, by volume, from 2 to 10 percent throughout the profile. These fragments are typically 2 to 20 millimeters in size.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is loam, clay loam, sandy loam, or silt loam. The Bw horizon has value of 3 to 5 and chroma of 3 or 4. It is loam or clay loam. The C horizon has hue of 10YR or 2.5Y and has no, few, or common mottles. It is loam or sandy loam.

Collinwood Series

The Collinwood series consists of moderately well drained, moderately slowly permeable or slowly permeable soils on till plains. These soils formed in clayey glaciolacustrine sediments. Slopes range from 0 to 6 percent.

Typical pedon of Collinwood silty clay, 0 to 2 percent slopes, 90 feet west and 60 feet south of the northeast corner of sec. 17, T. 105 N., R. 40 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; firm; neutral; abrupt smooth boundary.

A—8 to 13 inches; black (10YR 2/1) silty clay, very dark gray (10YR 3/1) dry; moderate very fine and fine subangular blocky structure; firm; neutral; clear smooth boundary.

AB—13 to 18 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; few dark grayish brown (10YR 4/2) worm casts; moderate very fine and fine subangular blocky structure; firm; neutral; clear smooth boundary.

BA—18 to 24 inches; dark grayish brown (2.5Y 4/2) silty clay; very dark gray (10YR 3/1) coatings on peds; moderate very fine and fine subangular blocky structure; firm; neutral; clear smooth boundary.

Bw—24 to 34 inches; dark grayish brown (2.5Y 4/2) silty clay; very dark gray (10YR 3/1) coatings on peds; few fine distinct light olive brown (2.5Y 5/4) mottles; moderate medium prismatic structure parting to moderate very fine subangular blocky; firm; neutral; clear smooth boundary.

C1—34 to 42 inches; grayish brown (2.5Y 5/2) silty clay; common fine distinct olive (5Y 5/4) and few fine distinct light yellowish brown (2.5Y 6/4) mottles; weak thin platy structure; firm; slight effervescence; mildly alkaline; clear smooth boundary.

C2—42 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam; many fine prominent yellowish brown (10YR 5/8) and few fine faint olive gray (5Y 5/2) mottles; weak thin to thick platy structure; firm; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 24 to 54 inches. The mollic epipedon ranges from 14 to 24 inches in thickness.

The A horizon has value of 2 or 3. It is silty clay or silty clay loam. The Bw horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 2 to 4. It is silty clay, clay, or silty clay loam. The C horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 2 to 4. It is silty clay, clay, silty clay loam, or silt loam.

Crippin Series

The Crippin series consists of somewhat poorly drained, moderately permeable soils on till plains and moraines. These soils formed in loamy glacial till. Slopes are 1 to 3 percent.

Typical pedon of Crippin loam, 1,200 feet north and 200 feet east of the southwest corner of sec. 24, T. 105 N., R. 42 W.

Ap—0 to 11 inches; black (N 2/0) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; about 2 percent coarse fragments; slight effervescence; mildly alkaline; abrupt smooth boundary.

AB—11 to 17 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; about 2 percent coarse fragments; slight effervescence; mildly alkaline; gradual smooth boundary.

Bw1—17 to 21 inches; dark grayish brown (10YR 4/2) loam; many black (10YR 2/1) worm casts; weak fine subangular blocky structure; friable; about 3 percent coarse fragments; strong effervescence; moderately alkaline; gradual smooth boundary.

Bw2—21 to 28 inches; dark grayish brown (2.5Y 4/2) loam; few fine distinct olive gray (5Y 5/2) mottles; weak fine subangular blocky structure; friable; few fine threads of lime; about 5 percent coarse fragments; strong effervescence; moderately alkaline; gradual smooth boundary.

BC—28 to 35 inches; olive brown (2.5Y 4/4) loam; common coarse prominent olive gray (5Y 5/2) and common medium prominent yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; many fine threads and soft accumulations of lime; about 8 percent coarse fragments; violent effervescence; moderately alkaline; gradual smooth boundary.

Cg—35 to 60 inches; olive gray (5Y 5/2) loam; common medium prominent light yellowish brown (2.5Y 6/4), few medium prominent yellowish brown (10YR 5/6), and few fine faint light olive gray (5Y 6/2) mottles; massive; friable; many fine threads and medium soft accumulations of lime; few iron and manganese oxide masses; about 8 percent coarse fragments; violent effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to 48 inches. The depth to free carbonates ranges from 0 to 10 inches. The mollic epipedon ranges from 14 to 24

inches in thickness. The content of coarse fragments ranges, by volume, from 2 to 10 percent throughout the profile. These fragments are dominantly 2 to 20 millimeters in size.

The A horizon is black (N 2/0) or has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is loam or clay loam. The Bw horizon has value of 3 to 5 and chroma of 1 to 4. It is loam or clay loam. The C horizon has hue of 10YR, 2.5Y, or 5Y and chroma of 2 to 4.

Egeland Series

The Egeland series consists of well drained, moderately rapidly permeable soils on outwash plains, stream terraces, and moraines. These soils formed in a loamy mantle, which is underlain by sandy glacial outwash. Slopes range from 0 to 6 percent.

Typical pedon of Egeland sandy loam, 0 to 2 percent slopes, 1,950 feet south and 110 feet east of the northwest corner of sec. 1, T. 108 N., R. 41 W.

Ap—0 to 9 inches; very dark gray (10YR 3/1) sandy loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; very friable; about 2 percent coarse fragments; slightly acid; abrupt smooth boundary.

Bw1—9 to 19 inches; dark grayish brown (10YR 4/2) sandy loam, brown (10YR 4/3) dry; weak coarse prismatic structure parting to weak medium subangular blocky; very friable; about 2 percent coarse fragments; neutral; clear smooth boundary.

Bw2—19 to 26 inches; dark brown (10YR 4/3) sandy loam; weak coarse prismatic structure parting to weak coarse subangular blocky; very friable; about 2 percent coarse fragments; neutral; clear smooth boundary.

BC—26 to 36 inches; dark yellowish brown (10YR 4/4) loamy sand; weak coarse prismatic structure parting to weak medium subangular blocky; very friable; few thin strata of sandy loam; about 3 percent coarse fragments; neutral; clear wavy boundary.

C1—36 to 45 inches; yellowish brown (10YR 5/4) loamy sand; weak medium subangular blocky structure; very friable; about 3 percent coarse fragments; slight effervescence; mildly alkaline; gradual smooth boundary.

C2—45 to 60 inches; yellowish brown (10YR 5/4) sand; single grain; loose; few thin strata of silt loam; about 8 percent coarse fragments; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 25 to 45 inches. The mollic epipedon ranges from 8 to 16 inches in thickness. The content of coarse fragments ranges, by volume, from 0 to 5 percent in the solum and from 2 to 10 percent in the C horizon.

The A horizon has value of 2 or 3 and chroma of 1.5 or less. It is sandy loam or loam. The B horizon has hue of 10YR or 2.5Y, value of 3 or 4, and chroma of 2 to 4. It is sandy loam or fine sandy loam. The C horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. It is loamy sand, sand, or loamy fine sand.

Everly Series

The Everly series consists of well drained, moderately permeable or moderately slowly permeable soils on ground moraines. These soils formed in loamy glacial till. Slopes range from 2 to 14 percent.

Typical pedon of Everly clay loam, 2 to 4 percent slopes, 2,490 feet north and 150 feet east of the southwest corner of sec. 35, T. 108 N., R. 39 W.

Ap—0 to 9 inches; black (10YR 2/1) clay loam, dark gray (10YR 4/1) dry; weak very fine and fine subangular blocky structure; friable; medium acid; abrupt smooth boundary.

AB—9 to 13 inches; mixed very dark gray (10YR 3/1) (A part) and dark brown (10YR 4/3) (B part) clay loam, very dark grayish brown (10YR 3/2) crushed, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; neutral; clear wavy boundary.

Bw—13 to 21 inches; dark yellowish brown (10YR 4/4) clay loam; common very dark grayish brown (10YR 3/2) worm casts; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

2BC—21 to 31 inches; brown (10YR 5/3) loam; weak fine subangular blocky structure; firm; common medium accumulations of lime; few iron oxide stains on faces of peds; about 3 percent coarse fragments; strong effervescence; mildly alkaline; clear smooth boundary.

2C1—31 to 41 inches; yellowish brown (10YR 5/4) loam; few medium distinct gray (10YR 6/1) mottles; massive; firm; many medium accumulations of lime; many iron oxide stains on faces of peds; about 6 percent coarse fragments; strong effervescence; mildly alkaline; clear wavy boundary.

2C2—41 to 60 inches; yellowish brown (10YR 5/4) loam; common medium distinct gray (10YR 6/1) and few fine prominent strong brown (7.5YR 5/6)

mottles; massive; firm; few medium accumulations of lime; many iron oxide stains on faces of peds; few fine accumulations of manganese oxide; about 6 percent coarse fragments; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 24 to 40 inches. Free carbonates are in the lower part of the solum. The content of coarse fragments ranges, by volume, from 0 to 5 percent in the solum and from 2 to 8 percent in the C horizon.

The A horizon is clay loam or loam that has a high content of silt or is silty clay loam that has a high content of sand. It has value of 2 or 3 and chroma of 1 or 2. The B and C horizons are clay loam or loam. The B horizon has value of 4 or 5 and chroma of 3 or 4. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 3 or 4.

Flom Series

The Flom series consists of poorly drained, moderately slowly permeable soils on moraines. These soils formed in loamy glacial material on moraines. Slopes are 0 to 2 percent.

Typical pedon of Flom clay loam, 2,240 feet north and 700 feet west of the southeast corner of sec. 11, T. 107 N., R. 42 W.

Ap—0 to 8 inches; black (N 2/0) clay loam, very dark gray (10YR 3/1) dry; moderate very fine subangular blocky structure; friable; about 2 percent coarse fragments; neutral; abrupt smooth boundary.

A—8 to 16 inches; black (N 2/0) clay loam, very dark gray (10YR 3/1) dry; moderate very fine subangular blocky structure; friable; about 2 percent coarse fragments; neutral; gradual smooth boundary.

AB—16 to 23 inches; very dark gray (10YR 3/1) clay loam, dark gray (10YR 4/1) dry; few medium olive gray (5Y 5/2) worm casts; weak very fine and fine subangular blocky structure; friable; about 2 percent coarse fragments; neutral; gradual wavy boundary.

Bg—23 to 33 inches; olive gray (5Y 5/2) clay loam; many medium prominent olive brown (2.5Y 4/4) mottles; weak medium prismatic structure parting to moderate fine and medium subangular blocky; friable; about 2 percent coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

Cg1—33 to 39 inches; light olive gray (5Y 6/2) clay loam; many fine prominent olive brown (2.5Y 4/4) mottles; weak fine and medium subangular blocky structure; friable; few masses of manganese oxide; common iron stains on faces of peds; about 5 percent coarse fragments; strong effervescence; moderately alkaline; gradual smooth boundary.

Cg2—39 to 60 inches; light olive gray (5Y 6/2) clay loam; many fine prominent olive brown (2.5Y 4/4) and few fine faint light gray (5Y 7/1) mottles; massive; friable; many manganese oxide and iron oxide stains on faces of peds; about 8 percent coarse fragments; strong effervescence; moderately alkaline.

The depth to free lime ranges from 14 to 35 inches and in most pedons coincides with the thickness of the solum. The mollic epipedon ranges from 15 to 24 inches in thickness. The content of coarse fragments ranges, by volume, from 2 to 10 percent throughout the profile. These fragments are dominantly 2 to 25 millimeters in diameter.

The A horizon is neutral in hue and has value of 2 or 3, or it has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1. The B horizon has hue of 2.5Y or 5Y, value of 4 or 5, and chroma of 1 or 2. It is clay loam, loam, or silty clay loam that is high in content of sand. The C horizon is clay loam or loam.

Fordville Series

The Fordville series consists of well drained soils on terraces, outwash plains, and uplands. These soils formed in loamy glacial outwash, which is underlain by gravelly sand. Permeability is moderate in the upper part of the profile and rapid in the lower part. Slopes range from 0 to 6 percent.

Typical pedon of Fordville loam, 2 to 6 percent slopes, about 2,200 feet east and 70 feet north of the southwest corner of sec. 5, T. 106 N., R. 42 W.

Ap—0 to 7 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine and medium subangular blocky structure; friable; neutral; abrupt smooth boundary.

Bw1—7 to 15 inches; very dark gray (10YR 3/1) loam, very dark grayish brown (10YR 3/2) dry; moderate medium prismatic structure parting to weak medium subangular blocky; friable; few black (10YR 2/1) worm casts; about 2 percent coarse fragments; neutral; clear wavy boundary.

Bw2—15 to 21 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; moderate medium prismatic structure parting to medium subangular blocky; friable; few very dark gray (10YR 3/1) worm casts; about 3 percent

coarse fragments; neutral; clear wavy boundary.
BC—21 to 27 inches; brown (10YR 4/3) sandy clay loam; weak medium prismatic structure parting to fine subangular blocky; very friable; about 5 percent coarse fragments; neutral; clear wavy boundary.
2C1—27 to 38 inches; dark brown (10YR 4/3) gravelly loamy sand; single grain; loose; about 20 percent coarse fragments; strong effervescence; mildly alkaline; gradual wavy boundary.
2C2—38 to 60 inches; olive brown (2.5Y 4/4) gravelly sand; single grain; loose; about 25 percent coarse fragments; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 20 to 40 inches. The mollic epipedon ranges from 16 to 26 inches in thickness. The content of coarse fragments ranges, by volume, from 0 to 10 percent in the solum and from 20 to 30 percent in the 2C horizon. These fragments are dominantly 2 to 30 millimeters in diameter.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is loam or silt loam. The Bw horizon has value of 2 to 4 and chroma of 1 to 4. It is loam, silt loam, or clay loam. The BC horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 2 or 3. It is sandy loam, sandy clay loam, loam, or clay loam. The 2C horizon has value of 4 to 6 and chroma of 2 to 4. It is loamy sand to stratified gravelly coarse sand.

Fulda Series

The Fulda series consists of poorly drained, slowly permeable or moderately slowly permeable soils on moraines. These soils formed in clayey glaciolacustrine sediments. Slopes are 0 to 2 percent.

Typical pedon of Fulda silty clay, 300 feet west and 100 feet north of the southeast corner of sec. 13, T. 108 N., R. 42 W.

Ap—0 to 9 inches; black (N 2/0) silty clay, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure; friable; mildly alkaline; abrupt smooth boundary.
A—9 to 16 inches; black (N 2/0) silty clay, very dark gray (10YR 3/1) dry; moderate very fine subangular blocky structure; firm; mildly alkaline; gradual smooth boundary.
Bg1—16 to 23 inches; very dark gray (5Y 3/1) silty clay, dark gray (10YR 4/1) dry; many medium distinct very dark grayish brown (2.5Y 3/2) and few fine prominent yellowish brown (10YR 5/6) mottles; moderate very fine angular blocky structure; firm; few very dark gray (5Y 3/1) worm casts; mildly alkaline; clear smooth boundary.
Bg2—23 to 33 inches; dark grayish brown (2.5Y 4/2) silty clay; common medium prominent yellowish brown (10YR 5/6) mottles; weak and moderate very fine angular blocky structure; firm; slight effervescence; mildly alkaline; gradual smooth boundary.
BCg—33 to 41 inches; olive gray (5Y 4/2) silty clay; common medium prominent light brownish gray (2.5Y 6/2) mottles; moderate very fine angular blocky structure; firm; many iron oxide stains on faces of peds; strong effervescence; moderately alkaline; clear smooth boundary.
Cg—41 to 60 inches; olive gray (5Y 5/2) silty clay loam; many medium prominent yellowish brown (10YR 5/6) and common medium distinct light brownish gray (2.5Y 6/2) mottles; massive; firm; many iron oxide stains on faces of peds; common medium lime masses; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 24 to 50 inches. The depth to free carbonates ranges from 20 to 30 inches. The mollic epipedon ranges from 14 to 24 inches in thickness.

The A horizon is black (N 2/0) or has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1. It is silty clay or silty clay loam. The B and BC horizons have value of 3 to 5. They are silty clay, clay, silty clay loam, or clay loam. The C horizon has hue of 2.5Y or 5Y, value of 5 or 6, and chroma of 1 or 2. It is silty clay, silty clay loam, or clay loam.

Glencoe Series

The Glencoe series consists of very poorly drained, moderately slowly permeable soils on moraines. These soils formed in loamy glacial material. Slopes are 0 to 1 percent.

Typical pedon of Glencoe silty clay loam, 2,520 feet west and 70 feet north of the southeast corner of sec. 30, T. 107 N., R. 40 W.

Ap—0 to 9 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; weak fine subangular blocky structure; friable; slightly acid; abrupt smooth boundary.
A—9 to 22 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; moderate fine subangular blocky structure; friable; slightly acid; clear wavy boundary.

ABg—22 to 33 inches; very dark gray (5Y 3/1) silty clay loam, dark gray (5Y 4/1) dry; weak fine subangular blocky structure; friable; few tongues of olive gray (5Y 4/2) material; about 2 percent coarse fragments; neutral; gradual irregular boundary.

Bg—33 to 46 inches; olive gray (5Y 4/2) clay loam; few fine faint dark grayish brown (2.5Y 4/2) mottles; weak fine subangular blocky structure; firm; few tongues of very dark gray (5Y 3/1) material; about 4 percent coarse fragments; neutral; gradual wavy boundary.

C—46 to 60 inches; olive (5Y 4/3) clay loam; few medium distinct grayish brown (2.5Y 5/2) mottles; massive; firm; about 4 percent coarse fragments; slight effervescence; neutral.

The thickness of the solum and the depth to free lime range from 36 to 54 inches. The thickness of the mollic epipedon ranges from 24 to 42 inches. The content of coarse fragments ranges, by volume, from 0 to 5 percent in the solum and from 2 to 8 percent in the C horizon. These fragments are dominantly 2 to 20 millimeters in diameter. The solum is silty clay loam, loam, or clay loam.

The A horizon has hue of 10YR, 2.5Y, or 5Y, value of 2 or 3, and chroma of 1, or it is neutral in hue and has value of 2 or 3. The B horizon has hue of 5Y or 2.5Y, value of 4 or 5, and chroma of 1 or 2. The C horizon has hue of 5Y or 2.5Y, value of 4 to 6, and chroma of 2 to 4. It is clay loam or loam.

Hamerly Series

The Hamerly series consists of moderately well drained, moderately permeable soils on moraines. These soils formed in loamy glacial till. Slopes are 1 to 3 percent.

Typical pedon of Hamerly loam, 2,550 feet west and 1,250 feet south of the northeast corner of sec. 19, T. 108 N., R. 42 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure; friable; about 3 percent coarse fragments; slight effervescence; mildly alkaline; abrupt smooth boundary.

A—8 to 13 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; few black (10YR 2/1) and olive brown (2.5Y 4/4) worm casts; weak and moderate very fine subangular blocky structure; friable; about 3 percent coarse fragments; strong effervescence; moderately alkaline; clear irregular boundary.

ABk—13 to 20 inches; dark brown (10YR 4/3) (A part) and olive brown (2.5Y 4/4) (B part) loam; many very dark gray (10YR 3/1) worm casts; weak fine subangular blocky structure; friable; common soft masses of lime; about 3 percent coarse fragments; violent effervescence; moderately alkaline; clear irregular boundary.

Bk—20 to 31 inches; light olive brown (2.5Y 5/4) loam; massive; friable; few medium concretions of iron oxide; common soft masses of lime; about 5 percent coarse fragments; violent effervescence; moderately alkaline; gradual smooth boundary.

C1—31 to 42 inches; light olive brown (2.5Y 5/4) loam; few fine distinct light brownish gray (2.5Y 6/2) mottles; massive; friable; few iron oxide stains on faces of peds; about 5 percent coarse fragments; strong effervescence; moderately alkaline; gradual smooth boundary.

C2—42 to 60 inches; light olive brown (2.5Y 5/4) loam; many medium distinct light brownish gray (2.5Y 6/2) and common medium prominent yellowish brown (10YR 5/6) mottles; massive; friable; many iron oxide stains on faces of peds; about 5 percent coarse fragments; strong effervescence; moderately alkaline.

The A horizon has hue of 10YR or 2.5Y. The ABk horizon, if it occurs, has hue of 10YR or 2.5Y, value of 3 to 6, and chroma of 1 to 4. It is loam or clay loam. The Bk and C horizons have hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 1 to 4. They are loam or clay loam. The content of coarse fragments ranges, by volume, from 1 to 10 percent in the ABk, Bk, and C horizons.

Hidewood Series

The Hidewood series consists of poorly drained, moderately permeable or moderately slowly permeable soils on moraines. These soils formed in silty and loamy glacial till. Slopes are 0 to 2 percent.

Typical pedon of Hidewood silty clay loam, 2,075 feet south and 75 feet east of the northwest corner of sec. 18, T. 106 N., R. 43 W.

Ap—0 to 8 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; moderate very fine subangular blocky structure; friable; neutral; clear smooth boundary.

A—8 to 16 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak and moderate very fine subangular blocky structure; friable;

neutral; clear smooth boundary.
AB—16 to 21 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (N 4/0) dry; moderate very fine and fine subangular blocky structure; friable; few grayish brown (2.5Y 5/2) streaks; neutral; clear irregular boundary.
Bg1—21 to 25 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) crushed; few fine distinct light yellowish brown (2.5Y 6/4) mottles; common medium very dark gray (10YR 3/1) worm casts; weak fine subangular blocky structure; friable; mildly alkaline; clear irregular boundary.
Bg2—25 to 31 inches; grayish brown (2.5Y 5/2) silty clay loam; few fine distinct light yellowish brown (2.5Y 6/4) mottles; weak fine and medium subangular blocky structure; friable; mildly alkaline; clear smooth boundary.
2Cg1—31 to 47 inches; olive (5Y 5/3) loam; common medium prominent olive yellow (2.5Y 6/8) mottles; massive; friable; few thin lenses of sand; about 4 percent coarse fragments; slight effervescence; mildly alkaline; gradual smooth boundary.
2Cg2—47 to 60 inches; light olive gray (5Y 6/2) clay loam; many large prominent yellowish brown (10YR 5/6) mottles; massive; firm; many iron oxide stains; about 5 percent coarse fragments; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 20 to 40 inches. The content of coarse fragments ranges, by volume, from 0 to 2 percent in the silty mantle and from 2 to 10 percent in the underlying material. These fragments are dominantly 2 to 25 millimeters in size.

The A horizon is neutral in hue or has hue of 2.5Y or 10YR. It has value of 2 or 3. The Bg horizon has hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 1 or 2. It is silty clay loam or silt loam. The 2C horizon has hue of 2.5Y or 5Y and chroma of 1 to 3. It either is clay loam or loam or is silt loam or silty clay loam high in content of sand.

Jeffers Series

The Jeffers series consists of poorly drained soils on moraines. These soils formed in loamy glacial till. Permeability is moderate in the upper part of the profile and moderately slow in the lower part. Slopes are 0 to 2 percent.

Typical pedon of Jeffers clay loam, 2,200 feet east and 1,200 feet south of the northwest corner of sec. 26, T. 108 N., R. 39 W.

Ap—0 to 10 inches; black (10YR 2/1) clay loam, dark gray (2.5Y 4/1) dry; weak fine subangular blocky structure; friable; few fine gypsum crystals in root channels; about 1 percent coarse fragments; strong effervescence; mildly alkaline; abrupt smooth boundary.
A—10 to 18 inches; very dark gray (2.5Y 3/1) clay loam, gray (2.5Y 5/1) dry; weak fine subangular blocky structure; friable; few fine gypsum crystals in root channels; about 1 percent coarse fragments; violent effervescence; mildly alkaline; clear wavy boundary.
BA—18 to 22 inches; dark gray (2.5Y 4/1) clay loam; few fine faint dark grayish brown (2.5Y 4/2) mottles; weak fine subangular blocky structure; friable; few fine gypsum crystals in root channels; few very dark gray (2.5Y 3/1) worm casts; about 2 percent coarse fragments; violent effervescence; moderately alkaline; clear wavy boundary.
Bkg—22 to 30 inches; grayish brown (2.5Y 5/2) clay loam; common fine distinct light olive brown (2.5Y 5/4) mottles; weak fine and medium subangular blocky structure; friable; many fine gypsum threads; few iron oxide stains; many fine lime masses; about 5 percent coarse fragments; violent effervescence; moderately alkaline; clear wavy boundary.
Bk—30 to 35 inches; light olive brown (2.5Y 5/4) clay loam; common medium prominent dark yellowish brown (10YR 4/6) mottles; weak fine and medium subangular blocky structure; friable; many fine gypsum threads; few iron oxide stains; many fine lime masses; about 5 percent coarse fragments; violent effervescence; moderately alkaline; gradual wavy boundary.
2C1—35 to 47 inches; light olive brown (2.5Y 5/4) clay loam; many large prominent yellowish brown (10YR 5/6) mottles; massive; firm; common iron oxide stains; many fine lime masses; about 8 percent coarse fragments; violent effervescence; moderately alkaline; gradual wavy boundary.
2C2—47 to 60 inches; light olive brown (2.5Y 5/4) clay loam; common large prominent olive gray (5Y 5/2) mottles; massive; firm; many iron oxide stains; many fine lime masses; about 8 percent coarse fragments; strong effervescence; moderately alkaline.

The solum ranges from 26 to 40 inches in thickness. The thickness of the mollic epipedon ranges from 14 to 24 inches. The calcium carbonate equivalent is 5 to 25 percent, and a calcic horizon is below a depth of 16 inches. Gypsum makes up 1 to 5 percent of the solum.

The content of coarse fragments ranges, by volume, from 1 to 8 percent throughout the profile. These fragments are 2 to 20 millimeters in size.

The B and 2C horizons are clay loam or loam. The B horizon has value of 4 or 5. The 2C horizon has hue of 2.5Y or 5Y, value of 4 or 5, and chroma of 2 to 4.

Knoke Series

The Knoke series consists of very poorly drained, moderately slowly permeable soils in former lake basins on till plains. These soils formed in silty lacustrine sediments. Slopes are 0 to 1 percent.

Typical pedon of Knoke silty clay loam, 300 feet north and 100 feet west of the southeast corner of sec. 33, T. 107 N., R. 39 W.

Ap—0 to 10 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; common snail shell fragments; strong effervescence; mildly alkaline; abrupt smooth boundary.

A—10 to 20 inches; black (5Y 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine and medium subangular blocky structure; friable; many snail shell fragments; violent effervescence; moderately alkaline; clear smooth boundary.

Ag1—20 to 28 inches; very dark gray (5Y 3/1) silty clay loam, gray (10YR 5/1) dry; few medium distinct dark grayish brown (2.5Y 4/2) mottles; weak fine prismatic structure parting to weak fine and medium angular and subangular blocky; friable; few snail shell fragments; strong effervescence; mildly alkaline; clear smooth boundary.

Ag2—28 to 37 inches; very dark gray (5Y 3/1) silty clay loam, dark gray (10YR 4/1) dry; many medium distinct dark grayish brown (2.5Y 4/2) mottles; weak fine and medium prismatic structure parting to weak medium angular and subangular blocky; friable; many snail and clam shell fragments; violent effervescence; moderately alkaline; clear smooth boundary.

Bg1—37 to 47 inches; very dark gray (5Y 3/1) silty clay; common coarse prominent olive (5Y 4/3) mottles; weak medium prismatic structure parting to weak fine angular and subangular blocky; firm; few snail shell fragments; strong effervescence; mildly alkaline; gradual smooth boundary.

Bg2—47 to 60 inches; olive gray (5Y 4/2) silty clay; many large faint olive (5Y 4/3) mottles; massive; firm; common snail shell fragments; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 30 to 60 inches. The Ap or A horizon is silty clay loam or mucky silt loam. The Ag and B horizons are silty clay loam, silty clay, or clay loam. The upper part of the B horizon has value of 2 or 3 and chroma of 0 or 1. The lower part is neutral in hue or has hue of 2.5Y or 5Y. It has value of 4 or 5 and chroma of 0 to 2.

La Prairie Series

The La Prairie series consists of moderately well drained, moderately permeable soils on flood plains. These soils formed in loamy stream-deposited sediments. Slopes are 0 to 2 percent.

Typical pedon of La Prairie loam, 2,300 feet east and 500 feet south of the northwest corner of sec. 26, T. 107 N., R. 41 W.

A1—0 to 13 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

A2—13 to 25 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak medium prismatic structure parting to weak fine subangular blocky; friable; neutral; clear wavy boundary.

Bw—25 to 36 inches; very dark grayish brown (10YR 3/2) loam, dark gray (10YR 4/1) dry; weak medium and coarse prismatic structure parting to weak medium subangular blocky; friable; slight effervescence; mildly alkaline; gradual wavy boundary.

C1—36 to 49 inches; dark grayish brown (2.5Y 4/2) loam; weak fine subangular blocky structure; friable; few thin lenses of sand; about 2 percent coarse fragments; strong effervescence; moderately alkaline; gradual irregular boundary.

C2—49 to 60 inches; dark grayish brown (2.5Y 4/2) loam; few fine distinct light olive brown (2.5Y 5/4) mottles; massive; friable; many thin layers of loamy sand; about 5 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 16 to 40 inches. The depth to free lime ranges from 10 to 30 inches. The solum is loam, silt loam, or silty clay loam that is high in content of sand.

The A horizon has value of 2 or 3 and chroma of 1 or less. The B horizon has hue of 10YR, 2.5Y, or 5Y,

value of 2 to 4, and chroma of 1 to 3. The C horizon has hue of 10YR, 2.5Y, or 5Y, value of 3 to 5, and chroma of 1 to 3.

Lamoure Series

The Lamoure series consists of poorly drained, moderately slowly permeable or moderately permeable soils on flood plains. These soils formed in silty sediments. Slopes are 0 to 2 percent.

Typical pedon of Lamoure silty clay loam, occasionally flooded, 1,000 feet north and 50 feet west of the southeast corner of sec. 3, T. 105 N., R. 43 W.

Ap—0 to 11 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure; friable; strong effervescence; mildly alkaline; abrupt smooth boundary.

A—11 to 30 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak medium prismatic structure parting to weak fine subangular blocky; friable; strong effervescence; mildly alkaline; clear wavy boundary.

AC—30 to 38 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; many medium distinct dark gray (5Y 4/1) mottles; weak fine and medium prismatic structure parting to weak fine subangular blocky; friable; strong effervescence; mildly alkaline; gradual irregular boundary.

Cg—38 to 60 inches; dark gray (5Y 4/1) silty clay loam; few fine distinct grayish brown (2.5Y 5/2) mottles; massive; friable; violent effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 15 to 35 inches. The solum is silty clay loam that is less than 35 percent clay.

The A horizon has hue of 10YR, 2.5Y, or 5Y or is neutral in hue. The Cg horizon has hue of 2.5Y or 5Y, value of 3 to 5, and chroma of 1 or 2. It is dominantly silty clay loam or silt loam, but in some pedons it has sandy or loamy strata.

Letri Series

The Letri series consists of poorly drained, moderately slowly permeable soils on ground moraines. These soils formed in loamy glacial sediments over glacial till. Slopes are 0 to 2 percent.

Typical pedon of Letri clay loam, 1,900 feet north and 70 feet west of the southeast corner of sec. 26, T. 108 N., R. 39 W.

Ap—0 to 9 inches; black (N 2/0) clay loam, very dark gray (N 3/0) dry; weak fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

A—9 to 15 inches; black (N 2/0) clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; neutral; clear wavy boundary.

AB—15 to 20 inches; black (5Y 2/1) clay loam, very dark gray (5Y 3/1) dry; weak fine subangular blocky structure; friable; neutral; clear irregular boundary.

Bg—20 to 26 inches; dark grayish brown (2.5Y 4/2) clay loam; few medium distinct olive brown (2.5Y 4/4) and few fine prominent strong brown (7.5YR 5/6) mottles; weak fine and medium subangular blocky structure; friable; common iron oxide and manganese oxide stains; slight effervescence; mildly alkaline; clear wavy boundary.

2BCg—26 to 34 inches; olive gray (5Y 5/2) clay loam; common fine prominent light olive brown (2.5Y 5/4) mottles; weak fine and medium subangular blocky structure; firm; few large accumulations of manganese oxide; few iron oxide stains; about 4 percent coarse fragments; strong effervescence; mildly alkaline; clear wavy boundary.

2Cg1—34 to 46 inches; light brownish gray (2.5Y 6/2) loam; common fine distinct light olive brown (2.5Y 5/6) mottles; massive; firm; many iron oxide and manganese oxide stains; few medium soft accumulations of lime; about 4 percent coarse fragments; strong effervescence; moderately alkaline; clear smooth boundary.

2Cg2—46 to 60 inches; light olive brown (2.5Y 5/4) loam; many medium and coarse distinct light brownish gray (2.5Y 6/2) and few medium prominent yellowish brown (10YR 5/8) mottles; massive; firm; common iron oxide and manganese oxide stains; about 8 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 14 to 24 inches. The thickness of the solum and the depth to free lime range from 20 to 36 inches. The content of coarse fragments ranges, by volume, from 0 to 4 percent in the solum and from 2 to 8 percent in the 2C horizon.

The A horizon has hue of 10YR, 2.5Y, or 5Y, value of 2 or 3, and chroma of 1, or it is neutral in hue and has value of 2 or 3. It is clay loam or silty clay loam. The Bg horizon has hue of 2.5Y or 5Y and value of 4 or

5. It is clay loam or silty clay loam. The 2C horizon has hue of 10YR or 2.5Y and chroma of 2 to 4. It is loam or clay loam.

Lismore Series

The Lismore series consists of moderately well drained soils on moraines. These soils formed in silty sediments over loamy glacial till. Permeability is moderate in the upper part of the profile and moderately slow in the lower part. Slopes are 1 to 2 percent.

Typical pedon of Lismore silty clay loam, 2,300 feet north and 100 feet east of the southwest corner of sec. 30, T. 105 N., R. 42 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

A—8 to 15 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak medium prismatic structure parting to weak medium subangular blocky; friable; neutral; clear wavy boundary.

2Bw—15 to 21 inches; very dark grayish brown (10YR 3/2) clay loam, dark gray (10YR 4/1) dry; weak medium prismatic structure parting to moderate medium subangular blocky; friable; common dark grayish brown (2.5Y 4/2) worm casts; about 5 percent coarse fragments; neutral; gradual wavy boundary.

2BC—21 to 31 inches; dark grayish brown (2.5Y 4/2) (B part) and light olive brown (2.5Y 5/4) (C part) clay loam; weak medium prismatic structure parting to moderate medium subangular blocky; friable; few very dark grayish brown (10YR 3/2) worm casts; about 5 percent coarse fragments; slight effervescence; mildly alkaline; gradual wavy boundary.

2C1—31 to 47 inches; light olive brown (2.5Y 5/4) clay loam; common medium prominent light olive gray (5Y 6/2) mottles; massive; firm; about 5 percent coarse fragments; strong effervescence; moderately alkaline; gradual wavy boundary.

2C2—47 to 60 inches; light olive brown (2.5Y 5/4) clay loam; many medium prominent light olive gray (5Y 6/2) mottles; massive; firm; about 5 percent coarse fragments; violent effervescence; moderately alkaline.

The thickness of the solum ranges from 20 to 44 inches. The depth to free carbonates is more than 20 inches. The silty mantle ranges from 10 to 20 inches in thickness. It has no coarse fragments. The content of coarse fragments ranges, by volume, from 2 to 10 percent in the underlying material.

The A horizon has value of 2 or 3. It is silty clay loam or silt loam. The 2B and 2C horizons are clay loam or loam. The 2B horizon has value of 2 to 4 and chroma of 1 to 3. The 2C horizon has hue of 2.5Y or 5Y, value of 4 or 5, and chroma of 2 to 4.

Lura Series

The Lura series consists of very poorly drained, slowly permeable soils on till plains and moraines. These soils formed in clayey glaciolacustrine sediments over loamy glacial till. Slopes are 0 to 1 percent.

Typical pedon of Lura silty clay, 2,000 feet west and 100 feet north of the southeast corner of sec. 36, T. 106 N., R. 40 W.

Ap—0 to 10 inches; black (N 2/0) silty clay, very dark gray (5Y 3/1) dry; moderate fine angular blocky structure; friable; neutral; abrupt smooth boundary.

A1—10 to 25 inches; black (N 2/0) silty clay, very dark gray (N 3/0) dry; moderate very fine angular blocky structure; firm; neutral; clear smooth boundary.

A2—25 to 41 inches; very dark gray (5Y 3/1) silty clay, very dark gray (N 3/0) dry; few fine distinct olive (5Y 4/3) mottles; weak coarse prismatic structure parting to moderate very fine angular blocky; firm; neutral; clear smooth boundary.

Bg—41 to 50 inches; olive gray (5Y 4/2) silty clay; few fine prominent light olive brown (2.5Y 5/6) and few medium faint olive (5Y 5/3) mottles; weak coarse prismatic structure parting to moderate very fine angular blocky; firm; few small snail shells and shell fragments; slight effervescence; mildly alkaline; clear smooth boundary.

Cg—50 to 60 inches; olive gray (5Y 5/2) silty clay; many medium prominent yellowish brown (10YR 5/6) mottles; massive; firm; many snail shells and thin layers of cretaceous material; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 40 to more than 60 inches. The mollic epipedon ranges from 30 to 60 inches in thickness. The content of clay in the control section is 45 to 60 percent.

The A horizon is neutral in hue and has value of 2 or 3, or it has hue of 10YR, 2.5Y, or 5Y, value of 2 or 3, and chroma of 1. It is silty clay or clay. The B horizon has chroma of 1 or 2. It is silty clay, clay, silty clay

loam, or clay loam. The C horizon has hue of 2.5Y or 5Y, value of 4 or 5, and chroma of 1 or 2. It is silty clay, clay, or clay loam.

Marysland Series

The Marysland series consists of poorly drained soils on outwash plains. These soils formed in loamy outwash over sandy material. Permeability is moderate in the upper part of the profile and rapid or very rapid in the lower part. Slopes are 0 to 2 percent.

Typical pedon of Marysland loam, 900 feet south and 100 feet west of the northeast corner of sec. 30, T. 108 N., R. 42 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, dark gray (10YR 4/1) dry; weak medium subangular blocky structure; friable; strong effervescence; moderately alkaline; abrupt smooth boundary.

A—9 to 17 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak fine and medium subangular blocky structure; friable; many medium black (10YR 2/1) worm casts; violent effervescence; moderately alkaline; clear irregular boundary.

Cg1—17 to 22 inches; grayish brown (2.5Y 5/2) loam; common fine distinct light olive brown (2.5Y 5/6) mottles; weak medium subangular blocky structure; friable; few fine dark gray (10YR 3/1) worm casts; few iron oxide stains; about 2 percent coarse fragments; violent effervescence; moderately alkaline; clear smooth boundary.

Cg2—22 to 27 inches; olive gray (5Y 5/2) loam; many coarse prominent yellowish brown (10YR 5/6) and few medium faint gray (5Y 6/1) mottles; massive; friable; about 7 percent coarse fragments; slight effervescence; moderately alkaline; clear wavy boundary.

2C—27 to 60 inches; grayish brown (2.5Y 5/2) gravelly coarse sand; common medium distinct pale olive (5Y 6/3) mottles; single grain; loose; about 25 percent coarse fragments; slight effervescence; moderately alkaline.

Free carbonates are throughout the profile. The thickness of the mollic epipedon ranges from 12 to 20 inches. The loamy outwash ranges from 20 to 40 inches in thickness. The content of coarse fragments ranges, by volume, from 0 to 10 percent in the loamy outwash.

The A horizon is neutral in hue and has value of 2 or 3, or it has hue of 10YR to 5Y. It is loam, clay loam, or sandy clay loam. The C horizon has value of 4 to 6 and chroma of 1 or 2. It is dominantly loam, clay loam, or sandy clay loam throughout. In the lower part, however, the range includes fine sandy loam and sandy loam. The 2C horizon is fine sand, sand, coarse sand, or stratified sand and gravel. The content of coarse fragments in this horizon ranges, by volume, from 10 to 30 percent.

Moines Series

The Moines series consists of somewhat poorly drained soils on moraines. These soils formed in loamy glacial till on uplands. Permeability is moderate in the upper part of the profile and moderately slow in the lower part. Slopes are 1 to 2 percent.

Typical pedon of Moines clay loam, 320 feet south and 400 feet west of the northeast corner of sec. 33, T. 108 N., R. 39 W.

Ap—0 to 10 inches; black (N 2/0) clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; about 1 percent coarse fragments; gypsum powder in root channels and few 1-millimeter gypsum crystals; slight effervescence; mildly alkaline; abrupt smooth boundary.

ABy—10 to 14 inches; very dark gray (2.5Y 3/1) clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; common dark grayish brown (2.5Y 4/2) worm casts; many fine threads of gypsum and 1- to 3-millimeter gypsum crystals; about 2 percent coarse fragments; strong effervescence; mildly alkaline; gradual smooth boundary.

Byg1—14 to 21 inches; olive brown (2.5Y 4/4) loam; common fine distinct grayish brown (2.5Y 5/2) mottles; weak fine subangular blocky structure; friable; common 1- to 5-millimeter gypsum crystals and diffuse gypsum powder; few very dark grayish brown (2.5Y 3/2) worm casts; about 4 percent coarse fragments; violent effervescence; moderately alkaline; clear smooth boundary.

Byg2—21 to 30 inches; light olive brown (2.5Y 5/4) loam; common fine distinct light brownish gray (2.5Y 6/2) mottles; weak fine subangular blocky structure; friable; many 1- to 5-millimeter gypsum crystals and accumulations; about 4 percent coarse fragments; violent effervescence; moderately alkaline; gradual wavy boundary.

Bkg—30 to 40 inches; light olive brown (2.5Y 5/4) loam; many medium distinct light brownish gray (2.5Y 6/2) mottles; weak fine subangular blocky structure; friable; many 1- to 5-millimeter gypsum crystals and aggregations; common iron oxide stains; few

medium masses of lime; about 5 percent coarse fragments; violent effervescence; moderately alkaline; gradual smooth boundary.

2Cg—40 to 60 inches; light yellowish brown (2.5Y 6/4) loam; many medium distinct light gray (2.5Y 7/2) and common medium prominent yellowish brown (10YR 5/6) mottles; massive; firm; about 5 percent coarse fragments; violent effervescence; moderately alkaline.

The solum ranges from 24 to 45 inches in thickness. The thickness of the mollic epipedon ranges from 10 to 18 inches. The content of gypsum is 1 to 15 percent in the upper part of the A horizon and 5 to 30 percent in the lower part of the A horizon and in the upper part of the B horizon. The content of coarse fragments ranges, by volume, from 1 to 8 percent in the solum. The texture is clay loam or loam throughout the profile.

The A horizon is black (N 2/0) or has hue of 10YR or 2.5Y, value of 2 or 3, and chroma of 1. The B horizon has chroma of 2 to 4. The C horizon has value of 4 to 6 and chroma of 2 to 4.

Nicollet Series

The Nicollet series consists of moderately well drained, moderately permeable soils on till plains and moraines. These soils formed in loamy glacial till. Slopes are 1 to 3 percent.

Typical pedon of Nicollet loam, 2,565 feet west and 100 feet south of the northeast corner of sec. 6, T. 106 N., R. 40 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

AB—9 to 16 inches; very dark brown (10YR 2/2) loam, dark gray (10YR 4/1) dry; moderate very fine and fine subangular blocky structure; friable; common black (10YR 2/1) worm casts; neutral; gradual smooth boundary.

Bw1—16 to 22 inches; dark brown (10YR 3/3) loam, dark grayish brown (10YR 4/2) dry; few fine distinct olive brown (2.5Y 4/4) mottles; moderate fine subangular blocky structure; friable; common very dark brown (10YR 2/2) and dark grayish brown (2.5Y 4/2) worm casts; about 2 percent coarse fragments; neutral; clear wavy boundary.

Bw2—22 to 28 inches; dark grayish brown (2.5Y 4/2) loam; common fine distinct olive brown (2.5Y 4/4) mottles; moderate fine and medium subangular blocky structure; friable; few dark brown (10YR 3/3) worm casts; about 2 percent coarse fragments; neutral; clear wavy boundary.

C1—28 to 42 inches; light olive brown (2.5Y 5/4) loam; common fine prominent gray (5Y 6/1) and few medium prominent yellowish brown (10YR 5/8) mottles; massive; friable; few soft lime masses; many iron oxide and manganese oxide stains; about 5 percent coarse fragments; strong effervescence; mildly alkaline; gradual smooth boundary.

C2—42 to 60 inches; light olive brown (2.5Y 5/4) loam; many medium prominent light olive gray (5Y 6/2) and many medium prominent yellowish brown (10YR 5/8) mottles; massive; firm; few soft lime masses; about 5 percent coarse fragments; strong effervescence; mildly alkaline.

The thickness of the solum and the depth to free carbonates range from 20 to 48 inches. The thickness of the mollic epipedon ranges from 12 to 24 inches. The content of coarse fragments ranges, by volume, from 0 to 8 percent throughout the profile. These fragments are typically 2 to 20 millimeters in size.

The A and Bw horizons are loam or clay loam. The A horizon has value of 2 or 3 and chroma of 1 or 2. The upper part of the Bw horizon has hue of 10YR or 2.5Y, value of 3 or 4, and chroma of 2 or 3. The lower part has value of 4 or 5 and chroma of 2 to 4. The Bw horizon has mottles in some or all parts. The C horizon has hue of 2.5Y or 5Y and chroma of 2 to 4. It has few or common masses of calcium carbonate in the upper part.

Oldham Series

The Oldham series consists of very poorly drained, moderately slowly permeable or slowly permeable soils in upland depressions. These soils formed in silty alluvial sediments. Slopes are 0 to 2 percent.

Typical pedon of Oldham silty clay loam, about 2,200 feet west and 200 feet south of the northeast corner of sec. 8, T. 108 N., R. 41 W.

A—0 to 16 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; weak very fine and fine subangular blocky structure; friable; many fragments of snail shells and threads of lime and gypsum; slight effervescence; mildly alkaline; gradual smooth boundary.

Ay—16 to 29 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular

blocky structure; friable; many fine gypsum crystals; strong effervescence; mildly alkaline; gradual smooth boundary.

By—29 to 40 inches; very dark gray (5Y 3/1) silty clay loam, dark gray (2.5Y 4/1) dry; few fine prominent light olive brown (2.5Y 5/4) mottles; weak fine subangular blocky structure; friable; many fine gypsum crystals; strong effervescence; mildly alkaline; clear smooth boundary.

BCg—40 to 46 inches; dark gray (5Y 4/1) (B part) and olive gray (5Y 5/2) (C part) clay loam; common medium prominent dark yellowish brown (10YR 4/4) mottles; weak fine subangular blocky structure; friable; few fine gypsum crystals; about 2 percent coarse fragments; strong effervescence; mildly alkaline; clear smooth boundary.

Cg—46 to 60 inches; gray (5Y 5/1) clay loam; many medium prominent dark yellowish brown (10YR 4/4) and many medium faint dark gray (5Y 4/1) mottles; massive; friable; about 2 percent coarse fragments; strong effervescence; mildly alkaline.

The thickness of the mollic epipedon ranges from 24 to 55 inches. The thickness of the solum ranges from 30 to 48 inches. The soils are calcareous throughout. The content of coarse fragments ranges, by volume, from 2 to 8 percent in the underlying glacial till.

The A and B horizons are silty clay loam or silty clay. They are black (N 2/0) or have hue of 10YR, 2.5Y, or 5Y and value of 2 or 3. The Cg horizon has hue of 2.5Y or 5Y, value of 3 to 5, and chroma of 1 or 2. It is clay loam, silt loam, silty clay loam, or silty clay.

Overly Series

The Overly series consists of moderately well drained soils on lake plains in the uplands. These soils formed in silty lacustrine sediments. Permeability is moderately slow in the upper part of the profile and moderately slow or slow in the lower part. Slopes are 1 to 3 percent.

Typical pedon of Overly silty clay loam, 2,400 feet north and 90 feet east of the southwest corner of sec. 31, T. 108 N., R. 41 W.

Ap—0 to 8 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

A—8 to 14 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; moderate very fine and fine subangular blocky structure; friable; mildly alkaline; gradual smooth boundary.

AB—14 to 19 inches; very dark grayish brown (10YR 3/2) silty clay loam, dark gray (10YR 4/1) dry; moderate very fine and fine subangular blocky structure; friable; many black (10YR 2/1) and few olive brown (2.5Y 4/4) worm casts; slight effervescence; mildly alkaline; gradual smooth boundary.

Bw—19 to 26 inches; brown (10YR 4/3) silty clay loam; weak fine and medium subangular blocky structure; friable; few dark gray (10YR 4/1) worm casts; strong effervescence; moderately alkaline; clear smooth boundary.

C1—26 to 37 inches; light olive brown (2.5Y 5/4) silty clay loam; few fine prominent yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; few dark grayish brown (2.5Y 4/2) worm casts; few concretions of iron oxide; few lime accumulations; strong effervescence; moderately alkaline; clear smooth boundary.

C2—37 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam; few fine prominent yellowish brown (10YR 5/6) mottles; massive; friable; many iron oxide stains and concretions; few lime accumulations; thin bands of sandy and silty material; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 16 to 36 inches. The mollic epipedon ranges from 16 to 30 inches in thickness.

The A horizon has value of 2 or 3. It is silty clay loam, silt loam, silty clay, or clay loam. The B horizon has hue of 10YR or 2.5Y, value of 2 to 4 in the upper part and 3 to 5 in the lower part, and chroma of 1 to 3 throughout. It is silty clay loam, silt loam, or clay loam. The C horizon has hue of 2.5Y or 10YR, value of 4 to 6, and chroma of 1 to 4. It is silty clay loam, silty clay, or clay loam.

Poinsett Series

The Poinsett series consists of well drained, moderately permeable soils on moraines. These soils formed in silty glacial drift. Slopes range from 2 to 6 percent.

Typical pedon of Poinsett silty clay loam, 2 to 4 percent slopes, 1,000 feet west and 800 feet north of the southeast corner of sec. 13, T. 108 N., R. 42 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam,

dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

Bw1—9 to 13 inches; dark brown (10YR 4/3) silty clay loam; weak medium prismatic structure parting to moderate fine and medium subangular blocky; friable; common black (10YR 2/1) worm casts; neutral; gradual wavy boundary.

Bw2—13 to 21 inches; dark brown (10YR 4/3) silty clay loam; weak medium prismatic structure parting to moderate fine and medium subangular blocky; friable; few very dark grayish brown (10YR 3/2) worm casts; mildly alkaline; clear wavy boundary.

Bk—21 to 29 inches; dark yellowish brown (10YR 4/4) silty clay loam; weak coarse prismatic structure parting to weak medium subangular blocky; friable; many medium masses of lime; violent effervescence; moderately alkaline; clear wavy boundary.

C1—29 to 41 inches; olive brown (2.5Y 4/4) silty clay loam; massive; friable; few medium lime masses; strong effervescence; moderately alkaline; clear wavy boundary.

C2—41 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam; common fine prominent yellowish brown (10YR 5/6) mottles; massive; friable; few lenses of sandy material; many large iron oxide stains; few iron oxide concretions; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to free lime range from 14 to 30 inches. The mollic epipedon ranges from 7 to 16 inches in thickness.

The A and Bw horizons are silty clay loam or silt loam. The A horizon has value of 2 or 3. The Bw horizon has hue of 10YR or 2.5Y, value of 2 to 4, and chroma of 1 to 4. The C horizon has hue of 2.5Y or 10YR and value of 4 to 6. It is dominantly silty clay loam or silt loam. The lower part of the B horizon and the C horizon, however, have thin laminations of very fine sand and fine sand in some pedons.

Quam Series

The Quam series consists of very poorly drained, moderately slowly permeable soils on moraines. These soils formed in silty glacial material over glacial till. Slopes are 0 to 1 percent.

Typical pedon of Quam silty clay loam, 1,250 feet east and 900 feet north of the southwest corner of sec. 20, T. 108 N., R. 41 W.

Ap—0 to 10 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; weak very fine granular structure; friable; neutral; abrupt smooth boundary.

A1—10 to 25 inches; black (N 2/0) silty clay loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; neutral; gradual smooth boundary.

A2—25 to 47 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; firm; neutral; gradual smooth boundary.

A3—47 to 57 inches; black (10YR 2/1) silty clay loam, dark gray (10YR 4/1) dry; few fine prominent dark gray (5Y 4/1) mottles; weak fine subangular blocky structure; firm; neutral; clear smooth boundary.

Cg—57 to 60 inches; olive gray (5Y 4/2) silty clay loam; few fine prominent light olive brown (2.5Y 5/4) mottles; massive; firm; few small accumulations of lime; about 5 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 24 to 80 inches. The texture is silty clay loam, silt loam, loam, or clay loam throughout the profile. The depth to free carbonates ranges from 20 to 60 inches.

The A horizon is black (N 2/0) or has hue of 10YR, 2.5Y, or 5Y and value of 2 or 3. Some pedons have a B horizon. This horizon has hue of 2.5Y or 5Y, value of 2 to 4 and chroma of 1, or it is neutral in hue and has value of 2 to 4. The C horizon has hue of 2.5Y or 5Y, value of 4 or 5, and chroma of 1 or 2. The content of coarse fragments in this horizon ranges, by volume, from 0 to 8 percent.

Rolfe Series

The Rolfe series consists of very poorly drained, slowly permeable soils on till plains. These soils formed in silty glacial material over loamy glacial till. Slopes are 0 to 1 percent.

Typical pedon of Rolfe silt loam, about 600 feet west and 1,500 feet north of the southeast corner of sec. 7, T. 107 N., R. 39 W.

Ap—0 to 10 inches; black (10YR 2/1) silt loam, dark gray (10YR 4/1) dry; moderate fine subangular blocky structure; friable; slightly acid; abrupt smooth boundary.

E—10 to 20 inches; dark gray (10YR 4/1) silt loam, light gray (10YR 6/1) dry; moderate medium platy structure parting to moderate very fine subangular blocky; friable; slightly acid; clear smooth boundary.

Btg1—20 to 27 inches; very dark gray (10YR 3/1) silty clay, gray (10YR 5/1) dry; few fine distinct dark yellowish brown (10YR 4/4) mottles; moderate fine and medium angular blocky structure; firm; common thin clay films on faces of peds; neutral; clear smooth boundary.

Btg2—27 to 36 inches; dark grayish brown (2.5Y 4/2) silty clay loam; few fine prominent dark yellowish brown (10YR 4/4) and few fine faint grayish brown (2.5Y 5/2) mottles; moderate fine and medium angular and subangular blocky structure; firm; common thin clay films on faces of peds; few manganese oxide stains on faces of peds; about 2 percent coarse fragments; neutral; gradual smooth boundary.

BCg—36 to 45 inches; olive gray (5Y 5/2) clay loam; many fine prominent yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; friable; many manganese oxide stains on faces of peds; about 2 percent coarse fragments; neutral; gradual smooth boundary.

Cg1—45 to 52 inches; olive gray (5Y 5/2) clay loam; many medium prominent yellowish brown (10YR 5/6) mottles; massive; friable; strata of fine sand; many manganese oxide stains on faces of peds; few iron oxide concretions; about 5 percent coarse fragments; slight effervescence; mildly alkaline; clear smooth boundary.

Cg2—52 to 60 inches; olive (5Y 5/3) clay loam; many large prominent yellowish brown (10YR 5/6) and many fine prominent strong brown (7.5YR 5/6) mottles; massive; friable; many manganese oxide stains on faces of peds; about 5 percent coarse fragments; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to free lime range from 40 to 50 inches. The A and E horizons are silt loam or loam. The A horizon has value of 2 or 3. The E horizon has value of 4 or 5 and chroma of 1 or 2. The Btg horizon has hue of 10YR, 2.5Y, or 5Y and value of 3 to 5. It is silty clay, silty clay loam, or clay loam. The Cg horizon has hue of 5Y or 2.5Y, value of 4 or 5, and chroma of 1 to 3. It is clay loam or loam. The content of coarse fragments in this horizon ranges, by volume, from 3 to 8 percent.

Sinai Series

The Sinai series consists of moderately well drained, slowly permeable soils on moraines. These soils formed in clayey glaciolacustrine sediments. Slopes are 1 to 2 percent.

Typical pedon of Sinai silty clay, 2,600 feet west and 600 feet north of the southeast corner of sec. 32, T. 107 N., R. 41 W.

A1—0 to 11 inches; black (10YR 2/1) silty clay, dark gray (10YR 4/1) dry; moderate fine granular structure; firm; neutral; clear smooth boundary.

A2—11 to 17 inches; very dark gray (10YR 3/1) silty clay, dark gray (10YR 4/1) dry; moderate very fine subangular blocky structure; firm; neutral; clear irregular boundary.

Bw1—17 to 26 inches; dark grayish brown (2.5Y 4/2) silty clay; weak medium prismatic structure parting to moderate very fine subangular blocky; firm; many very dark gray (10YR 3/1) tongues; neutral; clear irregular boundary.

Bw2—26 to 30 inches; dark grayish brown (2.5Y 4/2) silty clay; few fine distinct light yellowish brown (2.5Y 6/4) mottles; weak medium prismatic structure parting to very fine subangular blocky; firm; few dark gray (10YR 4/1) tongues; slight effervescence; mildly alkaline; gradual irregular boundary.

C1—30 to 39 inches; grayish brown (2.5Y 5/2) silty clay loam; common medium prominent yellowish brown (10YR 5/6) mottles; massive; friable; common soft accumulations of lime; violent effervescence; moderately alkaline; gradual smooth boundary.

C2—39 to 60 inches; grayish brown (2.5Y 5/2) silty clay loam; many medium prominent yellowish brown (10YR 5/6) and few fine prominent strong brown (7.5YR 5/6) mottles; massive; friable; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 17 to 34 inches. The thickness of the mollic epipedon ranges from 16 to 25 inches. The solum is silty clay or silty clay loam. The control section is 35 to 50 percent clay.

The A horizon has chroma of 1 or 2. The B horizon has hue of 10YR or 2.5Y, value of 2 to 4, and chroma of 1 to 3. The C horizon has hue of 10YR or 2.5Y, value of 3 to 6, and chroma of 1 to 6. It is dominantly silty clay or silty clay loam, but in some pedons it has thin strata of silt loam, clay loam, or loam below a depth of 40 inches.

Sioux Series

The Sioux series consists of excessively drained, rapidly permeable or very rapidly permeable soils on terrace escarpments, lakeshores, and gravelly ridges on moraines. These soils formed in gravelly and sandy glacial outwash. Slopes range from 2 to 40 percent.

Typical pedon of Sioux sandy loam, 2 to 40 percent slopes, 2,350 feet east and 350 feet south of the northwest corner of sec. 10, T. 108 N., R. 41 W.

A—0 to 7 inches; black (10YR 2/1) sandy loam, dark gray (10YR 4/1) dry; weak fine granular structure; very friable; about 10 percent coarse fragments; mildly alkaline; clear smooth boundary.

AC—7 to 13 inches; dark brown (10YR 3/3) gravelly sandy loam, brown (10YR 4/3) dry; single grain; very friable; about 30 percent gravel; slight effervescence; moderately alkaline; clear smooth boundary.

C—13 to 60 inches; yellowish brown (10YR 5/4) very gravelly sand; single grain; loose; about 50 percent gravel; strong effervescence; moderately alkaline.

The thickness of the solum ranges from 6 to 14 inches and is the same as the depth to sand and gravel. The depth to free carbonates ranges from 0 to 8 inches.

The A horizon is sandy loam, loam, loamy sand, gravelly sandy loam, gravelly loam, or gravelly loamy sand. It has value of 2 or 3. The AC horizon has value of 3 or 4 and chroma of 2 or 3. The content of coarse fragments ranges, by volume, from 5 to 35 percent in the A and AC horizons. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 4. It is very gravelly sand, very gravelly loamy sand, or extremely gravelly sand. The content of coarse fragments in this horizon ranges, by volume, from 35 to 65 percent.

Spicer Series

The Spicer series consists of poorly drained, moderately permeable soils on till plains and moraines. These soils formed in silty glaciolacustrine sediments. Slopes are 0 to 2 percent.

Typical pedon of Spicer silty clay loam, 1,600 feet west and 100 feet south of the northeast corner of sec. 21, T. 106 N., R. 40 W.

Ap—0 to 9 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; strong effervescence; mildly alkaline; abrupt smooth boundary.

AB—9 to 14 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; few medium dark grayish brown (2.5Y 4/2) tongues; strong effervescence; mildly alkaline; gradual irregular boundary.

Bg—14 to 24 inches; dark grayish brown (2.5Y 4/2) silty clay loam; few medium distinct olive (5Y 5/3) mottles; weak fine subangular blocky structure; friable; many medium very dark gray (10YR 3/1) tongues; strong effervescence; mildly alkaline; gradual wavy boundary.

BCg—24 to 31 inches; olive gray (5Y 5/2) silt loam; few fine faint yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; few fine very dark gray (10YR 3/1) tongues; strong effervescence; mildly alkaline; clear wavy boundary.

Cg1—31 to 38 inches; olive gray (5Y 5/2) silt loam; many medium prominent yellowish brown (10YR 5/8) and few fine prominent light gray (5Y 6/1) mottles; weak fine subangular blocky structure; friable; few medium lime accumulations; violent effervescence; moderately alkaline; clear wavy boundary.

Cg2—38 to 60 inches; gray (5Y 5/1) silt loam; common medium prominent yellowish brown (10YR 5/8) and common fine prominent light yellowish brown (2.5Y 6/4) mottles; massive; friable; many medium lime accumulations; violent effervescence; moderately alkaline.

The thickness of the solum ranges from 22 to 48 inches. The thickness of the mollic epipedon ranges from 12 to 24 inches. The solum and the C horizon are silt loam or silty clay loam.

The A horizon is neutral in hue and has value of 2 or 3, or it has hue of 10YR, value of 2 or 3, and chroma of 1. The B horizon has hue of 2.5Y or 5Y, value of 4 or 5, and chroma of 1 or 2. The C horizon has hue of 2.5Y or 5Y and value of 5 or 6.

Storden Series

The Storden series consists of well drained, moderately permeable soils on moraines and till plains. These soils formed in loamy glacial till. Slopes range from 6 to 40 percent.

Typical pedon of Storden loam, in an area of Storden-Clarion loams, 12 to 18 percent slopes, eroded; 2,250 feet north and 1,200 feet west of the southeast corner of sec. 15, T. 106 N., R. 39 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam; weak very fine subangular blocky structure; friable;

about 2 percent coarse fragments; strong effervescence; mildly alkaline; abrupt smooth boundary.

C1—8 to 20 inches; brown (10YR 5/3) loam; weak very fine and fine subangular blocky structure; friable; about 3 percent coarse fragments; strong effervescence; mildly alkaline; gradual wavy boundary.

C2—20 to 31 inches; yellowish brown (10YR 5/4) loam; massive; friable; about 3 percent coarse fragments; strong effervescence; mildly alkaline; clear wavy boundary.

C3—31 to 60 inches; light olive brown (2.5Y 5/4) loam; few medium distinct very pale brown (10YR 7/4) mottles; massive; friable; many soft masses of lime; few fine iron oxide stains; about 6 percent coarse fragments; strong effervescence; mildly alkaline.

The solum is 6 to 10 inches thick. The content of coarse fragments ranges, by volume, from 2 to 10 percent in the control section. The Ap horizon has value of 4 or 5 and chroma of 2 or 3. The C horizon has value of 5 or 6 and chroma of 2 to 6. It is loam or clay loam.

Svea Series

The Svea series consists of moderately well drained soils on moraines. These soils formed in loamy, calcareous glacial till. Permeability is moderate in the upper part of the profile and moderate or moderately slow in the lower part. Slopes are 1 to 3 percent.

Typical pedon of Svea loam, 1,920 feet east and 740 feet north of the southwest corner of sec. 27, T. 108 N., R. 43 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak very fine subangular blocky structure; friable; about 2 percent coarse fragments; neutral; abrupt smooth boundary.

A—8 to 14 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate very fine subangular blocky structure; friable; about 2 percent coarse fragments; neutral; clear wavy boundary.

AB—14 to 19 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; moderate very fine and fine subangular blocky structure; friable; few olive brown (2.5Y 4/4) worm casts; about 4 percent coarse fragments; neutral; gradual wavy boundary.

Bw—19 to 26 inches; olive brown (2.5Y 4/4) loam; weak coarse prismatic structure parting to moderate fine and medium subangular blocky; friable; few very dark gray (10YR 3/1) worm casts; about 4 percent coarse fragments; mildly alkaline; clear wavy boundary.

BC—26 to 30 inches; light olive brown (2.5Y 5/4) loam; few fine distinct light brownish gray (2.5Y 6/2) mottles; weak fine and medium subangular blocky structure; friable; about 5 percent coarse fragments; slight effervescence; mildly alkaline; gradual wavy boundary.

C1—30 to 41 inches; light olive brown (2.5Y 5/4) loam; common medium distinct light brownish gray (2.5Y 6/2) mottles; massive; friable; common medium lime masses; few iron oxide stains; about 5 percent coarse fragments; violent effervescence; moderately alkaline; gradual wavy boundary.

C2—41 to 60 inches; grayish brown (2.5Y 5/2) loam; many coarse prominent olive yellow (2.5Y 6/6) mottles; massive; friable; many iron oxide stains; about 8 percent coarse fragments; strong effervescence; moderately alkaline.

The solum ranges from 20 to 30 inches in thickness. It is loam, clay loam, or silt loam. The content of coarse fragments ranges, by volume, from 2 to 10 percent throughout the profile. These fragments are dominantly 2 to 25 millimeters in diameter.

The A horizon is neutral in hue or has hue of 10YR or 2.5Y. It has value of 2 or 3. The Bw horizon has hue of 10YR or 2.5Y, value of 2 to 4, and chroma of 1 to 4. The C horizon has value of 4 to 6 and chroma of 2 to 4. It is loam or clay loam.

Sverdrup Series

The Sverdrup series consists of well drained, moderately rapidly permeable soils on stream terraces, outwash plains, and moraines. These soils formed in loamy glacial material over sandy sediments. Slopes range from 0 to 12 percent.

Typical pedon of Sverdrup sandy loam, 2 to 6 percent slopes, 800 feet west and 120 feet south of the northeast corner of sec. 1, T. 107 N., R. 42 W.

Ap—0 to 8 inches; very dark gray (10YR 3/1) sandy loam, dark gray (10YR 4/1) dry; moderate fine and medium subangular blocky structure; friable; slightly acid; abrupt smooth boundary.

Bw1—8 to 15 inches; dark brown (10YR 4/3) sandy loam; weak fine and medium subangular blocky structure; friable; slightly acid; clear wavy boundary.

Bw2—15 to 28 inches; dark brown (10YR 4/3) loamy

sand; weak medium and coarse subangular blocky structure; friable; neutral; gradual wavy boundary.
C1—28 to 36 inches; brown (10YR 5/3) sand; single grain; loose; about 2 percent coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.
C2—36 to 60 inches; light yellowish brown (2.5Y 6/4) sand; single grain; loose; about 5 percent coarse fragments; slight effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 7 to 16 inches. The thickness of the solum and the depth to free lime range from 16 to 40 inches. The content of coarse fragments ranges, by volume, from 0 to 10 percent in the solum and from 0 to 15 percent in the C horizon.

The A horizon has value of 2 or 3. It is sandy loam or fine sandy loam. The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 4. It is fine sandy loam or loamy sand in the upper part and in some pedons is fine sand in the lower part. The C horizon has value of 4 to 6 and chroma of 2 to 4.

Terril Series

The Terril series consists of moderately well drained, moderately permeable soils on foot slopes in the uplands. These soils formed in loamy local colluvium and alluvium. Slopes range from 2 to 8 percent.

Typical pedon of Terril loam, 2 to 8 percent slopes, 1,740 feet west and 400 feet south of the northeast corner of sec. 14, T. 106 N., R. 39 W.

Ap—0 to 9 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; neutral; abrupt smooth boundary.
A1—9 to 26 inches; black (10YR 2/1) loam, very dark grayish brown (10YR 3/2) dry; weak very fine and fine subangular blocky structure; friable; neutral; gradual smooth boundary.
A2—26 to 35 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak fine and medium subangular blocky structure; friable; few black (10YR 2/1) worm casts; neutral; gradual smooth boundary.
Bw—35 to 43 inches; very dark grayish brown (10YR 3/2) loam, dark gray (10YR 4/1) dry; weak fine and medium subangular blocky structure; friable; few dark yellowish brown (10YR 3/4) worm casts; neutral; gradual smooth boundary.
BC—43 to 53 inches; dark yellowish brown (10YR 3/4) loam; weak fine and medium subangular blocky structure; friable; many dark brown (10YR 3/3) worm casts; about 2 percent coarse fragments; neutral; gradual smooth boundary.
C—53 to 60 inches; brown (10YR 5/3) loam; few fine distinct light gray (10YR 6/1) mottles; massive; friable; few iron oxide stains on faces of peds; few soft lime masses; about 5 percent coarse fragments; strong effervescence; mildly alkaline.

The thickness of the mollic epipedon ranges from 24 to 36 inches. The thickness of the solum ranges from 36 to 60 inches. The content of coarse fragments in the lower part of the B horizon and in the C horizon ranges, by volume, from 2 to 10 percent. These fragments are dominantly 2 to 20 millimeters in diameter. The soils are free of carbonates to a depth of at least 50 inches.

The A horizon has value of 2 or 3. It is loam, clay loam, or silt loam high in content of sand. The B and C horizons are loam or clay loam. The B horizon has value of 3 or 4 and chroma of 1 to 4. The C horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 2 to 4.

Vallers Series

The Vallers series consists of poorly drained, moderately slowly permeable soils on moraines. These soils formed in loamy glacial material. Slopes are 0 to 2 percent.

Typical pedon of Vallers clay loam, 1,300 feet west and 500 feet north of the southeast corner of sec. 14, T. 108 N., R. 42 W.

Ap—0 to 8 inches; black (N 2/0) clay loam, very dark gray (N 3/0) dry; weak very fine subangular blocky structure; friable; about 3 percent coarse fragments; strong effervescence; moderately alkaline; abrupt smooth boundary.
A—8 to 15 inches; black (N 2/0) clay loam, very dark gray (N 3/0) dry; moderate very fine subangular blocky structure; friable; about 3 percent coarse fragments; strong effervescence; moderately alkaline; clear wavy boundary.
ABk—15 to 23 inches; very dark gray (10YR 3/1) clay loam; few fine prominent yellowish brown (10YR 5/8) mottles; weak fine subangular blocky structure; friable; many dark grayish brown (2.5Y 4/2) worm casts; about 5 percent coarse fragments; violent effervescence; moderately alkaline; gradual wavy boundary.
Cg1—23 to 29 inches; olive gray (5Y 5/2) loam;

common medium prominent yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; about 5 percent coarse fragments; violent effervescence; moderately alkaline; gradual wavy boundary.

Cg2—29 to 40 inches; grayish brown (2.5Y 5/2) loam; many coarse prominent olive yellow (2.5Y 6/6) mottles; massive; friable; about 5 percent coarse fragments; strong effervescence; moderately alkaline; gradual wavy boundary.

Cg3—40 to 60 inches; olive gray (5Y 5/2) loam; common medium prominent olive yellow (2.5Y 6/6) mottles; massive; friable; about 5 percent coarse fragments; strong effervescence; moderately alkaline.

The mollic epipedon ranges from 10 to 24 inches in thickness. The content of coarse fragments ranges, by volume, from 2 to 8 percent in the control section. These fragments are dominantly 2 to 25 millimeters in size.

The A horizon is neutral in hue and has value of 2 or 3, or it has hue of 10YR to 5Y, value of 2 or 3, and chroma of 1. It is clay loam or silty clay loam. Some pedons have a B horizon. This horizon has hue of 10YR, 2.5Y, or 5Y, value of 3 to 5, and chroma of 1 or 2. It has distinct or prominent mottles. It is clay loam or loam. The C horizon has hue of 10YR, 2.5Y, or 5Y, value of 3 to 7, and chroma of 1 to 3. It is loam or clay loam.

Vienna Series

The Vienna series consists of well drained soils on ground moraines. These soils formed in silty loess over loamy glacial till. Permeability is moderate in the upper part of the profile and moderately slow in the lower part. Slopes range from 2 to 15 percent.

Typical pedon of Vienna silty clay loam, 2 to 4 percent slopes, 2,590 feet north and 2,520 feet west of the southeast corner of sec. 31, T. 106 N., R. 43 W.

Ap—0 to 10 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak very fine and fine subangular blocky structure; friable; slightly acid; abrupt smooth boundary.

Bw1—10 to 15 inches; dark brown (10YR 4/3) silty clay loam; moderate medium prismatic structure parting to weak fine and medium subangular blocky; friable; few black (10YR 2/1) worm casts; slightly acid; clear wavy boundary.

2Bw2—15 to 20 inches; dark yellowish brown (10YR 4/4) clay loam; moderate medium prismatic structure parting to weak fine subangular blocky; firm; about 4 percent coarse fragments; neutral; clear wavy boundary.

2Bk—20 to 26 inches; dark yellowish brown (10YR 4/4) clay loam; weak medium and coarse prismatic structure parting to weak medium subangular blocky; firm; few iron oxide stains on faces of peds; few soft lime masses; many pale brown (10YR 6/3) worm casts; about 5 percent coarse fragments; strong effervescence; mildly alkaline; gradual wavy boundary.

2C1—26 to 42 inches; yellowish brown (10YR 5/4) clay loam; weak medium and coarse subangular blocky structure; firm; common iron oxide stains on faces of peds; common soft lime masses; many light yellowish brown (10YR 6/4) worm casts; about 5 percent coarse fragments; violent effervescence; moderately alkaline; diffuse irregular boundary.

2C2—42 to 60 inches; pale brown (10YR 6/3) clay loam; massive; firm; many iron oxide stains on faces of peds; few soft lime masses; about 5 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 7 to 12 inches. The thickness of the solum ranges from 17 to 40 inches. The depth to free carbonates ranges from 14 to 30 inches. The thickness of the silty material ranges from 10 to 20 inches.

The A horizon has value of 2 or 3 and chroma of 1 or 2. It is silty clay loam or silt loam. The B and 2B horizons have hue of 10YR or 2.5Y, value of 2 to 4, and chroma of 1 to 4. The B horizon is silty clay loam or silt loam. The 2B horizon is loam or clay loam. It has few to many worm casts, which make up less than 25 percent of the material. The 2C horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 2 to 4. It is loam or clay loam.

Waldorf Series

The Waldorf series consists of poorly drained, moderately slowly permeable or moderately permeable soils on till plains. These soils formed in clayey glaciolacustrine sediments. Slopes are 0 to 1 percent.

Typical pedon of Waldorf silty clay, 2,600 feet west and 50 feet north of the southeast corner of sec. 22, T. 106 N., R. 40 W.

Ap—0 to 8 inches; black (N 2/0) silty clay, very dark gray (N 3/0) dry; moderate very fine and fine

subangular blocky structure; friable; neutral; abrupt smooth boundary.

A—8 to 16 inches; black (N 2/0) silty clay, very dark gray (N 3/0) dry; moderate medium angular blocky structure; firm; neutral; clear smooth boundary.

AB—16 to 21 inches; black (5Y 2/1) silty clay, very dark gray (5Y 3/1) dry; few fine faint dark olive gray (5Y 3/2) mottles; moderate fine angular blocky structure; firm; few olive gray (5Y 4/2) worm casts; neutral; clear smooth boundary.

Bg1—21 to 30 inches; olive gray (5Y 4/2) silty clay; few fine faint dark olive gray (5Y 3/2) mottles; weak medium prismatic structure parting to very fine angular blocky; firm; few tongues of black (5Y 2/1) material; neutral; clear smooth boundary.

Bg2—30 to 42 inches; olive gray (5Y 5/2) silty clay; few fine distinct olive (5Y 5/4) mottles; weak fine angular blocky structure; firm; many iron oxide stains on faces of peds; neutral; clear smooth boundary.

Cg—42 to 60 inches; light olive gray (5Y 6/2) silty clay; many medium prominent strong brown (7.5YR 5/6) and common fine faint olive (5Y 5/3) mottles; massive; firm; many iron oxide stains and masses; few thin threads of lime; slight effervescence; mildly alkaline.

The thickness of the solum ranges from 26 to 48 inches. The depth to free carbonates ranges from 26 to 55 inches. The mollic epipedon ranges from 16 to 24 inches in thickness.

The A horizon is black (N 2/0) or has hue of 10YR, 2.5Y, or 5Y, value of 2 or 3, and chroma of 1. It is silty clay or silty clay loam. The B horizon has hue of 2.5Y or 5Y and chroma of 1 or 2. It is silty clay, silty clay loam, or clay. The C horizon has hue of 2.5Y or 5Y, value of 5 or 6, and chroma of 1 or 2. It is silty clay, silty clay loam, clay, or silt loam.

Webster Series

The Webster series consists of poorly drained, moderately permeable soils on till plains and moraines. These soils formed in loamy glacial sediments. Slopes are 0 to 2 percent.

Typical pedon of Webster clay loam, 400 feet east and 70 feet north of the southwest corner of sec. 11, T. 106 N., R. 40 W.

Ap—0 to 9 inches; black (N 2/0) clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

A—9 to 16 inches; black (N 2/0) clay loam, very dark gray (10YR 3/1) dry; moderate fine subangular blocky structure; friable; neutral; gradual smooth boundary.

AB—16 to 20 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; common fine distinct very dark grayish brown (2.5Y 3/2) mottles; weak fine subangular blocky structure; friable; many very dark gray (10YR 3/1) worm casts; neutral; gradual smooth boundary.

BA—20 to 23 inches; very dark gray (10YR 3/1) clay loam; common fine distinct dark grayish brown (2.5Y 4/2) mottles; moderate very fine and fine subangular blocky structure; friable; few black (10YR 2/1) worm casts; about 2 percent coarse fragments; neutral; gradual smooth boundary.

Bg—23 to 30 inches; dark grayish brown (2.5Y 4/2) clay loam; few fine distinct olive (5Y 4/3) mottles; weak and moderate very fine and fine subangular blocky structure; friable; few iron and manganese oxide stains on faces of peds; about 5 percent coarse fragments; neutral; clear smooth boundary.

Cg1—30 to 41 inches; olive gray (5Y 5/2) clay loam; few fine prominent yellowish brown (10YR 5/4) mottles; weak fine subangular blocky structure; friable; many iron and manganese oxide stains on faces of peds; few threads of lime; about 5 percent coarse fragments; strong effervescence; mildly alkaline; clear smooth boundary.

Cg2—41 to 60 inches; olive (5Y 5/3) loam; common medium prominent dark yellowish brown (10YR 4/6) mottles; massive; common iron and manganese oxide stains on faces of peds; many soft lime masses; about 5 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to free lime range from 30 to 40 inches. The mollic epipedon ranges from 14 to 24 inches in thickness. The content of coarse fragments ranges, by volume, from 0 to 10 percent throughout the profile. These fragments are 2 to 20 millimeters in diameter.

The A horizon is black (N 2/0) or has hue of 10YR, value of 2 or 3, and chroma of 1. It is clay loam or silty clay loam. The BA horizon has hue of 10YR or 2.5Y, value of 3 or 4, and chroma of 1 or 2. The Bg horizon has hue of 5Y or 2.5Y, value of 4 or 5, and chroma of 1 or 2. The C horizon has hue of 5Y or 2.5Y, value of 4 to 6, and chroma of 1 to 3. It is loam, sandy loam, or clay loam.

Wilmonton Series

The Wilmonton series consists of moderately well drained, moderately slowly permeable soils on ground moraines. These soils formed in loamy glacial till. Slopes are 1 to 2 percent.

Typical pedon of Wilmonton clay loam, 300 feet north and 50 feet east of the southwest corner of sec. 4, T. 108 N., R. 39 W.

Ap—0 to 8 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; weak fine subangular blocky structure; friable; neutral; abrupt smooth boundary.

A—8 to 15 inches; very dark gray (10YR 3/1) clay loam, dark gray (10YR 4/1) dry; weak fine and medium subangular blocky structure; friable; neutral; gradual smooth boundary.

BA—15 to 20 inches; very dark grayish brown (10YR 3/2) clay loam; moderate fine and medium subangular blocky structure; friable; common very dark gray (10YR 3/1) worm casts; mildly alkaline; clear wavy boundary.

Bw—20 to 24 inches; olive brown (2.5Y 4/4) clay loam; few fine distinct grayish brown (2.5Y 5/2) mottles; moderate fine and medium subangular blocky structure; firm; about 3 percent coarse fragments; slight effervescence; mildly alkaline; clear wavy boundary.

C1—24 to 39 inches; light olive brown (2.5Y 5/4) clay loam; many fine prominent olive gray (5Y 5/2) and common fine prominent brownish yellow (10YR 6/6) mottles; massive; firm; many medium masses of lime; about 3 percent coarse fragments; violent effervescence; mildly alkaline; clear wavy boundary.

C2—39 to 60 inches; light yellowish brown (2.5Y 6/4) clay loam; common medium prominent olive gray (5Y 5/2) and few fine prominent yellowish brown (10YR 5/6) mottles; massive; firm; many medium masses of lime; few iron oxide stains on faces of peds; about 3 percent coarse fragments; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 14 to 24 inches. The solum ranges from 20 to 35 inches in thickness. The content of coarse fragments ranges, by volume, from 0 to 5 percent in the solum and from 2 to 10 percent in the C horizon. These fragments are dominantly 2 to 15 millimeters in diameter.

The A horizon is clay loam, silty clay loam, or loam. The Bw and C horizons are clay loam or loam. The Bw horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 2 to 4. The C horizon has hue of 10YR or 2.5Y and chroma of 2 to 4.

Formation of the Soils

Soils are naturally occurring, dynamic, three-dimensional bodies formed in place in mineral material on the surface of the earth. They formed in parent material acted upon by climate and living organisms and influenced by relief over a period of time. Soil formation is expressed by characteristic horizontal layers. These are genetically related horizons that represent changes that the original mineral material has undergone during soil formation.

Soils began to form in Murray County as weathered minerals released nutrients, which provided nutrition for simple plants and animals. The remains of dead plants and animals decomposed and were mixed with mineral material near the surface by living organisms. Decomposition of organic residue allowed nutrients to be recycled and taken up by other plants. Primary minerals weathered to form clay. Organic matter decomposed to form humus. Both of these processes resulted in the retention of moisture and nutrients for plant growth in the developing soil. Soil formation became evident as the surface layer darkened, structure developed, and the differentiation of horizons began.

Parent Material

The soils in Murray County formed in parent material deposited by the Des Moines lobe of the Late Wisconsin Glaciation. The Des Moines lobe protruded from a continental ice sheet in the Winnipeg lowland of southern Manitoba and moved through the Red River and Minnesota River preglacial lowlands, eventually reaching southern Iowa. Within the channel of the Minnesota River lowland, the ice moved southeastward. Along the margin of the ice sheet, however, it moved laterally *(9)*. The Des Moines lobe filled the Minnesota River lowland and rose on its southwestern side over the escarpment of the Coteau des Prairies *(15)*. The Des Moines lobe reached its lateral terminus on the crest of the Coteau, where lateral flow to the southwest produced the Bemis Moraine and progressively younger landforms as the ice withdrew northeastward.

Throughout its course in Murray County, the Des Moines lobe deposited calcareous, grayish glacial till. Des Moines lobe till is grayish only in areas of poor drainage. It is light brown, yellowish brown, or olive brown in areas of better drainage. Glacial till derived mostly from limestone and shale, such as Des Moines lobe till, is dominantly loam, has a high pH, is calcareous, and is dominated by montmorillonite in the clay fraction *(7)*.

Most of the soils in the county formed in glacial till that was deposited directly by glacial ice. Other soils formed in deposits derived from glacial till that were sorted and redeposited by wind and water.

A loess-covered ground moraine lies outside the Bemis Moraine in the southwestern part of the county. Loess overlies clay loam glacial till that is the oldest parent material in the county. This till was deposited in the form of a ground moraine by an extra-morainic feature of the Des Moines lobe outside the Bemis Moraine *(9)*. It represents the main outer feature of the Des Moines lobe. The moraine is underlain by loamy glacial till that was deposited in place as a conspicuous ridgelike form. Undrained depressions are rare on the dissected, well drained surface.

The Bemis Moraine is not uniformly expressed as a ridgelike form throughout its extent in Murray County. It is a conspicuous ridge called Buffalo Ridge in Cameron and Chanarambie Townships and a less prominent ridge called Summit Hill in Leeds Township. The moraine is weakly expressed in Moulton and Fenton Townships and decreases in elevation as it extends out of the county. The Buffalo Ridge and Summit Hill area of the Bemis Moraine is breached by a narrow gorge near Chandler. The gorge served as an outlet for glacial meltwater that ponded to the north between the moraine and the receding ice sheet.

Barnes, Buse, and Flom are the major soils formed in loamy glacial till on the Buffalo Ridge and Summit Hill parts of the Bemis Moraine. In these areas slopes are complex and are undulating to steep. Arvilla and Sverdrup soils formed in small areas of outwash on

some convex slopes on these parts of the Bemis Moraine. Clarion, Webster, and Nicollet soils formed in loamy glacial till on the weakly expressed part of the Bemis Moraine in Moulton and Fenton Townships. In these areas slopes are complex and are nearly level to rolling.

A ground moraine was deposited inside the Bemis Moraine by the actively retreating Des Moines lobe as it withdrew toward the Minnesota River Valley. The landscape is characterized by low relief and poor surface drainage. Slopes are complex and are nearly level to undulating.

The ground moraine is underlain mainly by loamy glacial till. Lacustrine sediments are of large extent, however, in some areas on the ground moraine. Small areas of sand or gravel outwash are on some convex slopes on the ground moraine.

Most of the soils on the ground moraine formed in loamy glacial till. Barnes and Flom are the major soils that formed at the higher elevations north and west of Slayton. Clarion and Webster are the major soils that formed at the lower elevations south and east of Slayton.

The retreat of the Des Moines lobe was accompanied by the release of large volumes of meltwater and the separation of ice masses, or stagnant ice, from the margin of the glacier. The sediment-rich meltwater drained into a series of lakes in Lowville and Skandia Townships. It deposited glaciolacustrine sediments in the lakebeds. Oldham soils formed in the fine textured sediments. Marysland soils formed in loamy sediments over sandy sediments near the edge of the lakebeds. Sverdrup and Arvilla soils formed in coarse textured sediments on the beaches of the former glacial lakes.

Stagnant ice from the receding Des Moines lobe produced distinctive landforms on the ground moraine. These are known as ice-walled lake plains, which were walled by the stagnant ice and floored by recently deposited glacial till. Areas of glacial till surrounded by stagnant ice were fed by sediment-rich streams flowing from the melting ice sheet. Sediments entered the temporary lakes and were sorted. The finer textured sediments were carried toward the center of the lake, and the coarse textured sediments were deposited along the lake beaches or near the mouth of the stream. As the climate warmed and the stagnant ice melted, the walls of the temporary lakes collapsed and the fine textured glaciolacustrine sediments were deposited, forming the high point of the local landscape. Glacial till is exposed downslope from the former lakes. The glaciolacustrine sediments, therefore, smoothed out some of the slope irregularities on the ground moraine and imparted a more nearly level appearance to the landscape. Areas of glaciolacustrine sediments are more predominant and larger in the southeastern part of the ground moraine than in the northwestern part. Collinwood and Waldorf soils formed in lacustrine sediments in the southeastern part. Fulda, Sinai, and Poinsett soils formed in lacustrine sediments on the ice-walled lake plains in the northwestern part. Egeland and Sverdrup soils formed on the sandy beaches of the ice-walled lake plains.

The Altamont Moraine is a stagnation moraine that closely parallels the southeast trend of the Bemis Moraine. The Altamont Moraine marks a stationary, recessional position of the Des Moines lobe as it retreated toward the Minnesota River. (See figure 1 under the heading "General Nature of the County.") A stagnation moraine is formed by stagnant ice that has stopped flowing because of separation from the margin of the ice sheet. The topographic features and glacial deposits are different from those in areas where the ice was active as it melted. The morphology of the Altamont Moraine, therefore, contrasts with that of the Bemis Moraine, which was formed by active ice. The Altamont Moraine is a slight swell compared to the well drained, conspicuous Bemis Moraine.

The Altamont Moraine is underlain mainly by loamy glacial till. Water-sorted sediments in the form of ice-walled lake plains and outwash plains, however, are common on the moraine. Slopes on the moraine are complex and are undulating to hilly.

Barnes, Buse, and Flom soils formed in glacial till at the higher elevations on the Altamont Moraine north and west of Currie. Clarion, Storden, and Webster are the major soils that formed in glacial till at the lower elevations of the moraine south and east of Currie. Sverdrup and Arvilla soils formed in sandy and gravelly sediments on outwash plains on the moraine. Numerous outwash plains are in the Lake Shetek area of the moraine. Fulda, Sinai, and Poinsett soils formed in lacustrine sediments in the northwestern part of the moraine. Collinwood and Waldorf soils formed in lacustrine sediments in the southeastern part. Egeland and Sverdrup soils formed on sandy beaches of glacial lakes.

A ground moraine on the Coteau slope was deposited as the Des Moines lobe actively retreated down the Coteau slope toward the Minnesota River Valley. This moraine is the youngest landscape in the county. Slopes are complex and are nearly level to undulating.

The ground moraine on the Coteau slope is underlain almost entirely by clay loam till, which overlies loam

basal till. The retreat of the Des Moines lobe down the Coteau slope was sufficiently active to preclude the separation of ice masses from the margin of the glacier. As a result, this part of the county has no ice-walled lake plains and very few outwash areas.

Everly, Letri, and Wilmonton soils formed in clay loam and loam glacial till on the Coteau slope ground moraine. Jeffers and Moines soils, which have a high content of gypsum (calcium sulfate), formed in low areas. They are influenced by ground water rich in calcium sulfate. The ground water flows northeast down the Coteau slope.

Meltwater channels carried meltwater away from the stagnated or retreating Des Moines lobe. Two meltwater channels in Murray County served as the major drainageways for large volumes of meltwater during the main period of glacial retreat. The first channel dissects the Bemis Moraine. It was formed by meltwater associated with the retreat of the Des Moines lobe as it deposited the ground moraine in the northwestern and central parts of the county. The meltwater ponded between the Bemis Moraine and the receding ice sheet. It eventually breached the Bemis Moraine and flowed southwest to the Big Sioux River. The second channel flows through and along the Altamont Moraine. It carried meltwater and sediments away from the stagnated ice sheet that formed the Altamont Moraine. The Des Moines River now flows through this meltwater channel.

The meltwater in the channels was rich in sediments. The sediments were sorted by particle size, depending on the stream velocity and the sediment load. Arvilla and Sioux soils formed in sandy and gravelly outwash on meltwater channel terraces. Fordville soils formed in loamy material over gravelly outwash on the meltwater channel terraces. Marysland and Biscay soils formed in loamy material over sandy outwash in the main stream of the meltwater channels. La Prairie and Lamoure soils formed in loamy and silty clay loam sediments in the main stream of the meltwater channels.

Climate

Given adequate time, climate will eventually dominate the soil-forming process *(7)*. Temperature and precipitation are the most commonly measured climatic factors that influence soil formation. Climate influences the chemical and physical reactions that are required for soil profile development. Climate also influences the type of natural vegetation that grows in a particular region. Murray County has a subhumid continental climate that favored the growth of grassland vegetation.

Temperature influences the physical, chemical, and biological activities that affect mineral weathering and microbial activities in the soils. The rate of the chemical and biological processes responsible for soil formation decreases during the winter because mineral weathering or microbial activities do not take place when soils are frozen. Alternate freezing and thawing cycles in the fall and spring create expansion and contraction pressures that rupture mineral material and increase the surface area available for mineral weathering. These cycles also play a role in the development of soil structure. Temperature influences the accumulation and decomposition of organic matter in soils. As temperature rises, the rate of organic decomposition and nutrient cycling increases. Temperature controls effective rainfall through its effect on potential evapotranspiration, which increases with increasing mean annual temperature.

Precipitation is essential to soil formation. Water is necessary for plant and animal growth and for the chemical reactions that involve mineral weathering. Water transports colloidal material and dissolved solids from one part of the profile to another. It transports the material downward or completely out of the profile through leaching, or it transports soluble salts upward through capillary action.

Living Organisms

The major effects of living organisms on soil formation are the capture of energy through photosynthesis by plants, the addition of organic material to the soil, the decomposition of organic material by microorganisms, and the mixing of organic and mineral material in the soil profile by animals. The decomposition of organic material facilitates nutrient cycling and the formation of humus.

The soils in Murray County formed under tall prairie grasses. The composition of these grasses varied, depending on local soil and moisture conditions. The dominant grasses were big bluestem, little bluestem, blue grama, sideoats grama, indiangrass, switchgrass, and needlegrass. The prairie vegetation also included many forbs, such as aster, goldenrod, sunflowers, blazing star, wild rose, and prairie clover. Reeds, sedges, rushes, and cattails grew on the wetlands. Trees and shrubs grew only in areas adjacent to streams and lakes. Fire played a major role in keeping trees from advancing onto the prairie. It also aided in maintaining diversity in the prairie plant community *(8)*.

The soils that formed under tall prairie grasses in Murray County are classified as Mollisols. Melanization,

the darkening of soil by the addition or organic matter, is the dominant soil-forming process in Mollisols. Organic matter is added to Mollisols mainly upon the annual death of the upper plant parts and the death or dieback of the roots of prairie vegetation. Most of the growth in grassland plant communities occurs in the roots rather than the upper plant parts. Therefore, most of the organic matter added to grassland soils is incorporated directly into the soil upon the death or dieback of roots. The roots have important effects on the structural properties of soils. Growing plant roots exert pressure that forms soil structural units. Channels made by the growing plant roots influence air and water movement through the soil *(7)*.

The preliminary function of microorganisms in the formation of Mollisols is the decomposition of large amounts of the organic matter added to the soils by grassland vegetation. Microorganisms quickly decompose herbaceous grasses. This process promotes rapid nutrient cycling, which makes nutrients available for uptake by plants. Bacteria are the dominant microorganisms in Mollisols. Dark humus is the end product of bacterial decomposition. The humus is important in retaining moisture and nutrients in the soil profile and in stabilizing soil structure.

Insect and animal life is important in sizing and reworking organic and mineral material in the soil profile. Insects mix the surface layer. This mixing increases the surface area available for the weathering and decompositon of minerals and organic matter. Earthworms decompose organic matter, mix the soil, and leave fertile worm casts in the soil. Rodents mix the soil and form channels that influence air and water movement through the soil. They are most active in well drained to excessively drained soils.

Relief

Relief, which is characterized by aspect, elevation, and slope, is the most influential factor in forming different kinds of soil in similar kinds of parent material. Relief also influences how climate affects soil formation. The movement and depth of ground water are largely controlled by relief.

Aspect and elevation influence climate mainly through their effects on temperature. Soils on south and west aspects warm up more quickly in the spring than soils on north and east aspects. Also, they lose more moisture through evapotranspiration during the growing season. Elevation affects the temperature under which soils form. The temperature increases as elevation decreases from west to east in Murray County. Barnes and Vienna soils generally are at the higher elevations in the western part of the county where the mean annual temperature is between 44 and 45 degrees F. Clarion and Everly soils generally are at the lower elevations in the eastern part of the county where the mean annual temperature is between 45 and 47 degrees F.

The most important influence of slope on soil formation is its effect on the movement of surface water. Slope or landscape position determines whether most of the precipitation that falls on a site is lost as surface runoff or is absorbed into the soil through infiltration. Surface runoff is more rapid on convex slopes than in nearly level areas, where most of the water is absorbed by the soil. Convex, sloping areas are therefore supplied with less water for soil formation and plant growth than are nearly level areas. Also, surface runoff generally carries some mineral particles downslope, resulting in natural erosion in the sloping areas. Low areas receive surface runoff from the surrounding uplands and are influenced by ground water. The water table is closer to the surface in low and depressional areas than in the higher areas.

Soil-landscape relationships are illustrated by toposequences, which are sequences of soils that generally have been influenced by similar soil-forming factors but are differentiated by relief. The soils have different profile characteristics because of different landscape positions.

Clarion, Nicollet, and Webster soils form a toposequence in areas of loamy glacial till on ground moraines in the central and southern parts of the county. The well drained Clarion soils formed on convex slopes. The moderately well drained, nearly level Nicollet soils formed on summits and in concave or nearly level areas adjacent to the Clarion soils. The poorly drained Webster soils formed in low drainageways. Because of their landscape position, Clarion soils have a thinner A horizon and a thinner solum and are shallower to carbonates than the Nicollet soils. The nearly level Nicollet soils formed in areas where precipitation was not lost as runoff. More water was available for increased plant growth, resulting in the addition of more organic matter to the A horizon. More water also was available for the leaching of carbonates through the profile and for the movement of organic matter and clay downward into the B horizon. These processes resulted in a thicker solum.

A yellowish brown C horizon in the Clarion soils indicates the oxidation of minerals under well drained, aerobic conditions. This color contrasts with the olive brown color in the C horizon of the Nicollet soils. The

olive brown color indicates that some reducing conditions occurred in the profile during periods when part of the soil profile was saturated. The Nicollet soils are influenced by a fluctuating seasonal high water table at a depth of about 2.5 to 5.0 feet. During part of the year, usually late summer, no part of the soil profile is saturated. Oxidation processes can occur during these periods. During other parts of the year, usually spring and fall, the lower part of the soil profile is saturated. Fluctuation of the water table also resulted in the formation of grayish mottles in the C horizon or the lower part of the B horizon. These mottles are in the part of the profile that was saturated for extended periods.

The poorly drained Webster soils formed in low drainageways that received runoff from the uplands. They also were influenced by a fluctuating seasonal high water table at a depth of 1 to 2 feet. Plants adapted to wet conditions added large amounts of organic matter to the A horizon of these soils. Organic matter accumulates in poorly drained soils because poorly oxidized conditions inhibit decomposition of the organic matter. The A horizon of Webster soils is therefore thicker and darker than that of Nicollet soils. Plentiful surface water has resulted in the leaching of carbonates through the profile and the movement of organic material and clay into the B horizon. The thickness of the solum, however, is similar to that of the Nicollet soils because water percolation through the profile is restricted by the high water table. Olive colors in the C horizon and mottles in the B and C horizons indicate that prolonged reducing conditions have occurred in the profile because of the high water table.

Toposequences that are similar to the Clarion-Nicollet-Webster toposequence in landscape position and drainage but differ in profile characteristics are evident in other areas of Murray County. Barnes, Svea, and Flom soils form a toposequence in areas of loamy glacial till on the ground moraine in the northwestern part of the county. Everly, Wilmonton, and Letri soils form a toposequence in areas of clay loam and loam glacial till on the Coteau slope ground moraine in the northeast corner of the county. Vienna, Lismore, and Hidewood soils form a toposequence in areas of loess and clay loam glacial till on the loess-covered ground moraine in the southwestern part of the county.

Hamerly, Vallers, and Quam soils form a toposequence influenced by ground water in closed drainage systems. These soils formed in loam glacial till in the northern and western parts of the county. The lateral movement of ground water carries soluble salts toward depressional areas. In a closed drainage system, water cannot escape from depressional areas. Instead, the water is removed by evapotranspiration when potential evapotranspiration exceeds precipitation. As the ground water is removed from the moderately well drained Hamerly and poorly drained Vallers soils surrounding the depressions, soluble salts, mainly calcium carbonates, are drawn upward with the water. Calcium carbonates are deposited at or near the surface of the Hamerly and Vallers soils. The very poorly drained Quam soils, which are in the depressions, are saturated for extended periods by ground water at or near the surface. Calcium carbonates are leached from the solum of these soils.

Crippin, Canisteo, and Glencoe soils form a toposequence in areas of loam glacial till in the central and southern parts of the county. Moines, Jeffers, and Glencoe soils form a toposequence in areas of clay loam and loam glacial till on the Coteau slope ground moraine in the northeastern part of the county.

Time

Time is required for the parent material to be changed into a natural body that has genetically related horizons. The length of time required depends on the other soil-forming factors. Relief has had the most influence on the time required for soil formation in Murray County. In nearly level to rolling areas, sufficient time has elapsed to allow the soils to form fully. There has not been enough time for full soil formation, however, in hilly to very steep areas.

The relative maturity of a soil is indicated by the degree of profile development. Immature soils are not characterized by complete horizon development. They have only A and C horizons because relief, recent deposition of parent material, or carbonates in the solum have inhibited soil formation. Buse and Storden soils formed on steep slopes where most of the precipitation was lost as surface runoff. The scarcity of moisture for plant growth and erosion of the surface layer have slowed soil formation. Lamoure soils formed on flood plains where the deposition of alluvial sediments has prevented the formation of a mature soil. Hamerly and Vallers soils formed in areas around depressions where capillary action has moved carbonates to the surface, preventing the formation of a B horizon.

Fully developed soil profiles have A, B, and C horizons that have formed during a sufficient period of time under favorable conditions. Most of the soils in Murray County have fully developed profiles.

The length of time that the soil-forming processes

have been active in the county corresponds to the retreat of the Des Moines lobe. In a geologic sense, the soils in the county are young. The soil-forming processes and profile development began after the glacial ice melted.

Human Activities

Human activities, mainly farming, have altered the natural properties of the soils in Murray County. Removal of the native vegetation and tillage of the surface layer have had the most significant effects on soil properties. Tillage removes the protective vegetative cover and exposes the surface to the erosive forces of wind and water. Soils on undulating to steep slopes are most susceptible to accelerated water erosion when they are tilled. In areas where erosion has removed a significant part of the A horizon, continued tillage mixes subsoil material with the A horizon. As a result, brownish colors from the B horizon are exposed on the convex slopes. Because of accelerated erosion of the surface layer in hilly and steep soils, some downslope soils have received thick deposits from the surrounding upland soils. Tillage and an insufficient plant cover have increased the susceptibility to soil blowing on soils that have a sandy or silty clay surface layer.

Crop production has interrupted the annual cycle of the return of nutrient-rich plant residue to the soil. Continued cropping lowers the organic matter content of soils over a number of years. The loss of organic matter in turn lowers the moisture- and nutrient-holding capacity of the soils. Continued cropping has resulted in a deterioration of the granular structure in the surface layer of grassland soils. Deterioration of soil structure and an insufficient plant cover have increased the runoff rate on the more sloping soils. An increased runoff rate reduces the amount of water available for leaching, thereby slowing the processes of soil formation.

The removal of vegetation, additions of fertilizer, and crop residue management have altered the fertility of soils. Drainage systems have lowered the water table and changed the natural drainage condition of soils in low and depressional areas. Human activities will continue to have a major influence on natural soil properties as cropland management becomes more intensive.

References

(1) American Association of State Highway and Transportation Officials. 1982. Standard specifications for highway materials and methods of sampling and testing. Ed. 13, 2 vols., illus.

(2) American Society for Testing and Materials. 1985. Standard test method for classification of soils for engineering purposes. ASTM Stand. D 2487.

(3) Anderson, H.W., Jr., and others. 1976. Water resources of the Des Moines River watershed, southwestern Minnesota. U.S. Geol. Surv., Hydrol. Invest. Atlas HA-553, 3 pp., illus.

(4) Anderson, H.W., Jr., and others. 1976. Water resources of the Rock River watershed, southwestern Minnesota. U.S. Geol. Surv., Hydrol. Invest. Atlas HA-555, 3 pp., illus.

(5) Austin, George S. 1972. The Sioux Quartzite, southwestern Minnesota. *In* Geology of Minnesota: A centennial volume. pp. 450-453, illus.

(6) Broussard, W.L., and others. 1973. Water resources of the Cottonwood River watershed, southwestern Minnesota. U.S. Geol. Surv., Hydrol. Invest. Atlas HA-466, 3 pp., illus.

(7) Buol, S.W., F.D. Hole, and R.J. Mc Cracken. 1973. Soil genesis and classification. 360 pp., illus.

(8) Heinselman, Miron L. 1975. Interpretation of Francis J. Marschner's map of the original vegetation of Minnesota. U.S. Dep. Agric., Forest Serv., North-Central Exp. Stn., 19 pp., illus.

(9) Matsch, Charles L. 1972. Quaternary geology of southwestern Minnesota. *In* Geology of Minnesota: A centennial volume. pp. 548-560, illus.

(10) Thiel, George A. 1956. Geology and underground waters of Minnesota. Minn. Geol. Surv., Bull. 31, 506 pp., illus.

(11) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus.

(12) United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conserv. Serv., U.S. Dep. Agric. Handb. 436, 754 pp., illus.

(13) United States Department of Agriculture, Soil Conservation Service. National resources inventory. (Available in the State Office of the Soil Conservation Service at St. Paul, Minnesota)

(14) United States Department of Agriculture, Soil Conservation Service. 1984. Minnesota drainage guide. 1 vol. (loose-leaf)

(15) Wright, H.E., Jr. 1972. Physiography of Minnesota. *In* Geology of Minnesota: A centennial volume. pp. 560-580, illus.

This page intentionally left blank.

Glossary

ABC soil. A soil having an A, a B, and a C horizon.

AC soil. A soil having only an A and a C horizon. Commonly, such soil formed in recent alluvium or on steep rocky slopes.

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Basal till. Compact glacial till deposited beneath the ice.

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation-exchange capacity.

Bedding planes. Fine stratifications, less than 5 millimeters thick, in unconsolidated alluvial, eolian, lacustrine, or marine sediments.

Bedding system. A drainage system made by plowing, grading, or otherwise shaping the surface of a flat field. It consists of a series of low ridges separated by shallow, parallel dead furrows.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on the contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Bisequum. Two sequences of soil horizons, each of which consists of an illuvial horizon and the overlying eluvial horizons.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

California bearing ratio (CBR). The load-supporting capacity of a soil as compared to that of a standard crushed limestone, expressed as a ratio. First standardized in California. A soil having a CBR of 16 supports 16 percent of the load that would be supported by standard crushed limestone, per unit area, with the same degree of distortion.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Catena. A sequence, or "chain," of soils on a landscape that formed in similar kinds of parent material but have different characteristics as a result of differences in relief and drainage.

Cation. An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a channer.

Chiseling. Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard compacted layers to a depth below normal plow depth.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Congeliturbate. Soil material disturbed by frost action.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which

classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Coprogenous earth (sedimentary peat). Fecal material deposited in water by aquatic organisms.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid

than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Erosion pavement. A layer of gravel or stones that remains on the surface after fine particles are removed by sheet or rill erosion.

Esker (geology). A narrow, winding ridge of stratified gravelly and sandy drift deposited by a stream flowing in a tunnel beneath a glacier.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fibric soil material (peat). The least decomposed of all organic soil material. Peat contains a large amount of well preserved fiber that is readily identifiable according to botanical origin. Peat has the lowest bulk density and the highest water content at saturation of all organic soil material.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity*.

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Fragipan. A loamy, brittle subsurface horizon low in porosity and content of organic matter and low or moderate in clay but high in silt or very fine sand. A fragipan appears cemented and restricts roots. When dry, it is hard or very hard and has a higher bulk density than the horizon or horizons above. When moist, it tends to rupture suddenly under pressure rather than to deform slowly.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gilgai. Commonly a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, the microrelief of Vertisols—clayey soils having a high coefficient of expansion and contraction with changes in moisture content.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also, the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial meltwater.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Glaciofluvial deposits (geology). Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and occur as kames, eskers, deltas, and outwash plains.

Glaciolacustrine deposits. Material ranging from fine clay to sand derived from glaciers and deposited in glacial lakes mainly by glacial meltwater. Many deposits are interbedded or laminated.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.6 centimeters) in diameter.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Hemic soil material (mucky peat). Organic soil material intermediate in degree of decomposition between the less decomposed fibric and the more decomposed sapric material.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Illuviation. The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Intake rate. The average rate of water entering the soil under irrigation. Most soils have a fast initial rate; the rate decreases with application time. Therefore, intake rate for design purposes is not a constant but is a variable depending on the net irrigation application. The rate of water intake in inches per hour is expressed as follows:

Less than 0.2	very low
0.2 to 0.4	low
0.4 to 0.75	moderately low
0.75 to 1.25	moderate

1.25 to 1.75	moderately high
1.75 to 2.5	high
More than 2.5	very high

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—
Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.
Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.
Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.
Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.
Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.
Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.
Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.
Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.
Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Kame (geology). An irregular, short ridge or hill of stratified glacial drift.

Karst (topography). The relief of an area underlain by limestone that dissolves in differing degrees, thus forming numerous depressions or small basins.

Lacustrine deposit (geology). Material deposited in lake water and exposed when the water level is lowered or the elevation of the land is raised.

Landslide. The rapid downhill movement of a mass of soil and loose rock, generally when wet or saturated. The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Leaching. The removal of soluble material from soil or other material by percolating water.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Coarse sandy loam, sandy loam, and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Some types are terminal, lateral, medial, and ground.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent* The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Muck. Dark colored, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Pan. A compact, dense layer in a soil that impedes the movement of water and the growth of roots. For example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan*.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Peat. Unconsolidated material, largely undecomposed organic matter, that has accumulated under excess moisture. (See Fibric soil material.)

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plinthite. The sesquioxide-rich, humus-poor, highly weathered mixture of clay with quartz and other diluents. It commonly appears as red mottles, usually in platy, polygonal, or reticulate patterns. Plinthite changes irreversibly to an ironstone hardpan or to irregular aggregates on repeated wetting and drying, especially if it is exposed also to heat from the sun. In a moist soil, plinthite can be cut with a spade. It is a form of laterite.

Plowpan. A compacted layer formed in the soil directly below the plowed layer.

Ponding. Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Productivity, soil. The capability of a soil for producing a specified plant or sequence of plants under specific management.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are—

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Regolith. The unconsolidated mantle of weathered rock and soil material on the earth's surface; the loose earth material above the solid rock.

Relief. The elevations or inequalities of a land surface, considered collectively.

Rill. A steep-sided channel resulting from accelerated erosion. A rill is generally a few inches deep and not wide enough to be an obstacle to farm machinery.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Saprolite (soil science). Unconsolidated residual material underlying the soil and grading to hard bedrock below.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Sequum. A sequence consisting of an illuvial horizon and the overlying eluvial horizon. (See Eluviation.)

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral formed is called quartz.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slick spot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Sloughed till. Water-saturated till that has flowed slowly downhill from its original place of deposit by glacial ice. It may rest on other till, on glacial outwash, or

on a glaciolacustrine deposit.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of coarse fragments in a soil. Generally, it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to soil blowing and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from soil blowing and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Subsoiling. Breaking up a compact subsoil by pulling a special chisel through the soil.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Terminal moraine. A belt of thick glacial drift that generally marks the termination of important glacial advances.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil. The upper part of the soil, which is the most

favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial meltwater. In nonglaciated regions, alluvium deposited by heavily loaded streams.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Varve. A sedimentary layer of a lamina or sequence of laminae deposited in a body of still water within a year. Specifically, a thin pair of graded glaciolacustrine layers seasonally deposited, usually by meltwater streams, in a glacial lake or other body of still water in front of a glacier.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically a sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1951-80 at Tracy, Minnesota)

Month	Temperature						Precipitation				
	Average daily maximum	Average daily minimum	Average	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days*	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January-----	21.4	0.8	11.1	48	-27	0	0.58	0.17	0.91	2	6.8
February----	27.3	7.1	17.2	53	-22	0	.80	.21	1.27	3	6.9
March-------	37.9	18.5	28.2	72	-11	17	1.56	.63	2.33	4	11.0
April-------	56.2	33.7	45.0	89	14	61	2.44	1.17	3.53	6	2.2
May---------	70.4	45.9	58.2	93	24	277	3.25	1.54	4.72	7	.0
June--------	80.1	56.3	68.2	98	39	546	3.72	2.27	5.02	7	.0
July--------	85.0	60.9	73.0	100	46	713	3.24	1.39	4.81	6	.0
August------	83.0	56.5	70.8	98	44	645	2.92	1.73	3.98	6	.0
September---	73.5	48.3	60.9	95	29	327	2.69	1.01	4.08	5	.0
October-----	61.8	37.6	49.7	88	16	136	1.86	.45	2.98	4	.8
November----	42.7	23.0	32.9	71	-6	0	1.21	.30	1.93	3	4.5
December----	27.9	9.6	18.8	53	-21	0	.76	.25	1.17	3	6.9
Yearly:											
Average---	55.6	33.4	44.5	---	---	---	---	---	---	---	---
Extreme---	---	---	---	102	-28	---	---	---	---	---	---
Total-----	---	---	---	---	---	2,722	25.03	19.27	30.45	56	39.1

* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50 degrees F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

(Recorded in the period 1951-80 at Tracy, Minnesota)

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	Apr. 30	May 13	May 19
2 years in 10 later than--	Apr. 25	May 7	May 15
5 years in 10 later than--	Apr. 16	Apr. 26	May 6
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 6	Sept. 27	Sept. 17
2 years in 10 earlier than--	Oct. 11	Oct. 3	Sept. 23
5 years in 10 earlier than--	Oct. 22	Oct. 13	Oct. 4

TABLE 3.--GROWING SEASON

(Recorded in the period 1951-80 at Tracy, Minnesota)

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	168	147	131
8 years in 10	175	154	138
5 years in 10	188	169	150
2 years in 10	201	183	161
1 year in 10	208	191	168

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
31F	Storden loam, 18 to 40 percent slopes	1,450	0.3
33B	Barnes loam, 2 to 4 percent slopes	28,030	6.1
33B2	Barnes loam, 3 to 6 percent slopes, eroded	29,310	6.4
36	Flom clay loam	21,020	4.6
51	La Prairie loam	1,350	0.3
70	Svea loam	12,040	2.6
86	Canisteo clay loam	15,445	3.4
94B	Terril loam, 2 to 8 percent slopes	5,435	1.2
96A	Collinwood silty clay, 0 to 2 percent slopes	11,050	2.4
96B	Collinwood silty clay, 2 to 6 percent slopes	4,570	1.0
102B	Clarion loam, 2 to 4 percent slopes	39,450	8.6
102B2	Clarion loam, 3 to 6 percent slopes, eroded	23,555	5.1
113	Webster clay loam	24,725	5.3
114	Glencoe silty clay loam	3,560	0.8
118	Crippin loam	5,045	1.1
127A	Sverdrup sandy loam, 0 to 2 percent slopes	440	0.1
127B	Sverdrup sandy loam, 2 to 6 percent slopes	2,930	0.6
127C	Sverdrup sandy loam, 6 to 12 percent slopes	640	0.1
130	Nicollet loam	19,300	4.2
140	Spicer silty clay loam	4,290	0.9
141A	Egeland sandy loam, 0 to 2 percent slopes	1,300	0.3
141B	Egeland sandy loam, 2 to 6 percent slopes	3,105	0.7
149B	Everly clay loam, 2 to 4 percent slopes	9,695	2.1
149B2	Everly clay loam, 3 to 6 percent slopes, eroded	4,150	0.9
149C2	Everly clay loam, 6 to 12 percent slopes, eroded	765	0.2
184	Hamerly loam	7,280	1.6
210	Fulda silty clay	2,100	0.5
211	Lura silty clay	2,170	0.5
212	Sinai silty clay	2,175	0.5
219	Rolfe silt loam	380	0.1
229	Waldorf silty clay	7,090	1.5
236	Vallers clay loam	19,570	4.3
241	Letri clay loam	5,670	1.2
246	Marysland loam	3,315	0.7
276	Oldham silty clay loam	3,660	0.8
284B	Poinsett silty clay loam, 2 to 4 percent slopes	3,700	0.8
284B2	Poinsett silty clay loam, 3 to 6 percent slopes, eroded	875	0.2
297B	Vienna silty clay loam, 2 to 4 percent slopes	9,845	2.1
297B2	Vienna silty clay loam, 3 to 6 percent slopes, eroded	5,215	1.1
339A	Fordville loam, 0 to 2 percent slopes	2,130	0.5
339B	Fordville loam, 2 to 6 percent slopes	1,780	0.4
341A	Arvilla sandy loam, 0 to 2 percent slopes	880	0.2
341B	Arvilla sandy loam, 2 to 6 percent slopes	4,655	1.0
341C	Arvilla sandy loam, 6 to 12 percent slopes	760	0.2
344	Quam silty clay loam	3,530	0.8
345	Wilmonton clay loam	4,730	1.0
359	Lamoure silty clay loam, frequently flooded	6,505	1.4
392	Biscay loam	1,280	0.3
402E	Sioux sandy loam, 2 to 40 percent slopes	235	0.1
418	Lamoure silty clay loam, occasionally flooded	14,350	3.1
436	Hidewood silty clay loam	6,300	1.4
437F	Buse loam, 18 to 40 percent slopes	3,375	0.7
470	Lismore silty clay loam	5,460	1.2
506	Overly silty clay loam	2,505	0.5
562	Knoke silty clay loam	3,030	0.7
590	Moines clay loam	1,400	0.3
594	Jeffers clay loam	4,440	0.9
894D2	Storden-Everly complex, 12 to 18 percent slopes, eroded	240	0.1
902C2	Barnes-Buse loams, 6 to 12 percent slopes, eroded	11,890	2.6
904B	Arvilla-Barnes-Buse complex, 2 to 6 percent slopes	1,895	0.4
904C	Arvilla-Barnes-Buse complex, 6 to 12 percent slopes	1,325	0.3
913D	Buse-Barnes loams, 12 to 18 percent slopes	2,145	0.5
917D	Buse-Sioux complex, 12 to 18 percent slopes	370	0.1
918D	Buse-Vienna complex, 12 to 18 percent slopes	300	0.1
920C2	Storden-Clarion-Arvilla complex, 6 to 15 percent slopes, eroded	965	0.2

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
921C2	Clarion-Storden loams, 6 to 12 percent slopes, eroded	9,270	2.0
960D2	Storden-Clarion loams, 12 to 18 percent slopes, eroded	2,100	0.5
964C2	Vienna-Buse complex, 6 to 12 percent slopes, eroded	660	0.1
1030	Pits, gravel-Udorthents complex	745	0.2
1051	Glencoe silty clay loam, ponded	2,615	0.6
1824	Quam silty clay loam, ponded	2,140	0.5
	Water	8,740	1.9
	Total	458,440	100.0

TABLE 5.--PRIME FARMLAND

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name)

Map symbol	Soil name
33B	Barnes loam, 2 to 4 percent slopes
33B2	Barnes loam, 3 to 6 percent slopes, eroded
36	Flom clay loam (where drained)
51	La Prairie loam
70	Svea loam
86	Canisteo clay loam (where drained)
94B	Terril loam, 2 to 8 percent slopes
96A	Collinwood silty clay, 0 to 2 percent slopes
96B	Collinwood silty clay, 2 to 6 percent slopes
102B	Clarion loam, 2 to 4 percent slopes
102B2	Clarion loam, 3 to 6 percent slopes, eroded
113	Webster clay loam (where drained)
114	Glencoe silty clay loam (where drained)
118	Crippin loam
130	Nicollet loam
140	Spicer silty clay loam (where drained)
141A	Egeland sandy loam, 0 to 2 percent slopes
141B	Egeland sandy loam, 2 to 6 percent slopes
149B	Everly clay loam, 2 to 4 percent slopes
149B2	Everly clay loam, 3 to 6 percent slopes, eroded
184	Hamerly loam
210	Fulda silty clay (where drained)
211	Lura silty clay (where drained)
212	Sinai silty clay
219	Rolfe silt loam (where drained)
229	Waldorf silty clay (where drained)
236	Vallers clay loam (where drained)
241	Letri clay loam (where drained)
246	Marysland loam (where drained)
276	Oldham silty clay loam (where drained)
284B	Poinsett silty clay loam, 2 to 4 percent slopes
284B2	Poinsett silty clay loam, 3 to 6 percent slopes, eroded
297B	Vienna silty clay loam, 2 to 4 percent slopes
297B2	Vienna silty clay loam, 3 to 6 percent slopes, eroded
339A	Fordville loam, 0 to 2 percent slopes
339B	Fordville loam, 2 to 6 percent slopes
344	Quam silty clay loam (where drained)
345	Wilmonton clay loam
392	Biscay loam (where drained)
418	Lamoure silty clay loam, occasionally flooded (where drained)
436	Hidewood silty clay loam (where drained)
470	Lismore silty clay loam
506	Overly silty clay loam
562	Knoke silty clay loam (where drained)
590	Moines clay loam
594	Jeffers clay loam (where drained)

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE

(Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability	Corn	Soybeans	Oats	Bromegrass-alfalfa hay	Bromegrass-alfalfa
		Bu	Bu	Bu	Tons	AUM*
31F---------- Storden	VIIe	---	---	---	---	---
33B---------- Barnes	IIe	90	32	75	3.3	5.2
33B2---------- Barnes	IIe	80	27	70	3.2	5.0
36---------- Flom	IIw	95	34	75	3.6	5.5
51---------- La Prairie	IIw	90	34	80	4.0	6.0
70---------- Svea	I	100	36	85	4.0	6.0
86---------- Canisteo	IIw	105	33	85	3.8	5.7
94B---------- Terril	IIe	100	36	85	4.8	7.2
96A---------- Collinwood	IIw	115	40	90	4.0	6.0
96B---------- Collinwood	IIe	105	35	80	3.8	5.7
102B---------- Clarion	IIe	105	35	85	4.6	6.9
102B2---------- Clarion	IIe	95	30	80	4.2	6.3
113---------- Webster	IIw	110	38	85	4.4	6.6
114---------- Glencoe	IIIw	95	34	75	3.5	5.2
118---------- Crippin	I	110	36	85	4.3	6.4
127A---------- Sverdrup	IIIs	60	20	50	2.7	4.0
127B---------- Sverdrup	IIIe	50	17	45	2.5	3.7
127C---------- Sverdrup	IVe	35	14	40	2.2	3.3
130---------- Nicollet	I	115	40	90	2.9	4.3

See footnote at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Oats	Bromegrass-alfalfa hay	Bromegrass-alfalfa
		Bu	Bu	Bu	Tons	AUM*
140---------- Spicer	IIw	105	33	60	2.9	4.3
141A---------- Egeland	IIIs	75	25	60	2.9	4.3
141B---------- Egeland	IIIe	65	22	50	2.8	4.2
149B---------- Everly	IIe	105	35	85	4.4	6.6
149B2---------- Everly	IIe	95	30	80	4.0	6.0
149C2---------- Everly	IIIe	80	27	70	2.7	4.0
184---------- Hamerly	IIs	90	30	80	3.4	5.1
210---------- Fulda	IIw	95	34	75	4.0	6.0
211---------- Lura	IIIw	90	32	70	3.5	5.2
212---------- Sinai	IIs	100	36	85	3.8	5.7
219---------- Rolfe	IIIw	90	28	70	3.5	5.2
229---------- Waldorf	IIw	110	38	85	4.0	6.0
236---------- Vallers	IIw	90	30	75	4.0	6.0
241---------- Letri	IIw	110	38	85	4.5	6.7
246---------- Marysland	IIw	80	25	65	3.5	5.2
276---------- Oldham	IIIw	80	26	70	3.5	5.2
284B---------- Poinsett	IIe	90	33	75	3.8	5.7
284B2---------- Poinsett	IIIe	80	28	70	3.6	5.4
297B---------- Vienna	IIe	90	33	75	4.2	6.3
297B2---------- Vienna	IIe	80	28	70	3.6	5.4
339A---------- Fordville	IIs	75	23	60	2.8	4.2

See footnote at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Oats	Bromegrass-alfalfa hay	Bromegrass-alfalfa
		Bu	Bu	Bu	Tons	AUM*
339B---------- Fordville	IIe	60	20	50	2.5	3.7
341A---------- Arvilla	IIIs	55	19	50	2.5	3.0
341B---------- Arvilla	IIIe	45	16	40	2.0	3.0
341C---------- Arvilla	IVe	30	12	35	1.5	2.2
344---------- Quam	IIIw	85	30	70	4.0	6.0
345---------- Wilmonton	I	115	40	90	4.5	6.7
359---------- Lamoure	VIw	---	---	---	---	---
392---------- Biscay	IIw	85	28	65	3.5	5.2
402E---------- Sioux	VIs	---	---	---	---	---
418---------- Lamoure	IIw	85	26	75	4.0	6.0
436---------- Hidewood	IIw	95	35	75	4.0	6.0
437F---------- Buse	VIIe	---	---	---	---	---
470---------- Lismore	I	100	37	85	4.3	6.4
506---------- Overly	I	100	32	80	4.0	6.0
562---------- Knoke	IIIw	90	28	70	3.5	5.2
590---------- Moines	IIs	100	30	80	4.0	6.0
594---------- Jeffers	IIw	105	32	85	3.5	5.2
894D2---------- Storden---------- Everly----------	IVe IIIe	45	---	40	2.4	3.6
902C2---------- Barnes-Buse	IIIe	40	15	35	1.9	2.8
904B---------- Arvilla---------- Barnes---------- Buse----------	IIIe IIe IIe	45	17	40	2.8	4.2

See footnote at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Land capability	Corn	Soybeans	Oats	Bromegrass-alfalfa hay	Bromegrass-alfalfa
		Bu	Bu	Bu	Tons	AUM*
904C		40	15	35	1.9	2.8
Arvilla	IVe					
Barnes	IIIe					
Buse	IIIe					
913D	IVe	40	---	35	2.3	3.5
Buse-Barnes						
917D		---	---	---	---	2.2
Buse	IVe					
Sioux	VIs					
918D	IVe	40	---	35	2.8	4.2
Buse-Vienna						
920C2		50	17	40	2.5	3.8
Storden	IVe					
Clarion	IIIe					
Arvilla	IIIe					
921C2	IIIe	75	25	65	3.8	5.7
Clarion-Storden						
960D2	IVe	45	---	40	3.2	4.8
Storden-Clarion						
964C2		60	20	60	3.4	5.1
Vienna	IVe					
Buse	IIIe					
1030. Pits-Udorthents						
1051	VIIIw	---	---	---	---	---
Glencoe						
1824	VIIIw	---	---	---	---	---
Quam						

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
31F. Storden					
33B, 33B2--------- Barnes	---	Eastern redcedar, Siberian peashrub, American plum, lilac.	Blue spruce, ponderosa pine, Russian olive, Siberian crabapple, bur oak.	Green ash, honeylocust.	Siberian elm.
36---------- Flom	---	Eastern redcedar, Siberian peashrub, lilac, common chokecherry, cotoneaster.	White spruce, blue spruce, Russian olive, bur oak.	Siberian elm, golden willow.	Eastern cottonwood.
51---------- La Prairie	---	Siberian peashrub, American plum, lilac.	Ponderosa pine, blue spruce, Siberian crabapple, eastern redcedar.	Golden willow, green ash, hackberry.	Eastern cottonwood, Siberian elm.
70---------- Svea	---	Siberian peashrub, American plum, lilac.	Ponderosa pine, blue spruce, Siberian crabapple, eastern redcedar.	Golden willow, green ash, hackberry.	Eastern cottonwood, Siberian elm.
86---------- Canisteo	---	Siberian peashrub, cotoneaster, lilac, northern whitecedar.	Hackberry, bur oak, white spruce, eastern redcedar.	Golden willow, honeylocust, green ash.	Eastern cottonwood.
94B---------- Terril	---	Gray dogwood, Siberian peashrub, redosier dogwood, lilac.	Honeylocust, Russian olive, Amur maple, blue spruce, northern whitecedar, eastern redcedar.	Eastern white pine, green ash.	---
96A, 96B---------- Collinwood	Lilac, Siberian peashrub, cotoneaster.	Manchurian crabapple, eastern redcedar.	Hackberry, green ash, Russian olive, Austrian pine, honeylocust.	Siberian elm------	---
102B, 102B2------- Clarion	---	Gray dogwood, redosier dogwood, lilac, Siberian peashrub.	Northern whitecedar, blue spruce, Amur maple, Russian olive, eastern redcedar, hackberry.	Green ash, eastern white pine.	---

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
113---------- Webster	---	Redosier dogwood, American plum, cotoneaster.	Hackberry, Amur maple, northern whitecedar, tall purple willow, white spruce.	Golden willow, green ash.	Eastern cottonwood, silver maple.
114---------- Glencoe	---	Redosier dogwood	Black ash, tall purple willow.	Black willow, golden willow, white willow.	---
118---------- Crippin	---	Northern whitecedar, cotoneaster, Siberian peashrub, lilac.	Hackberry, white spruce, eastern redcedar, bur oak.	Golden willow, green ash, honeylocust.	Eastern cottonwood.
127A, 127B, 127C-- Sverdrup	Lilac, Siberian peashrub, Peking cotoneaster.	Eastern redcedar, Manchurian crabapple, hackberry.	Siberian elm, honeylocust, Russian olive, ponderosa pine, green ash.	---	---
130---------- Nicollet	---	Redosier dogwood, lilac.	Northern whitecedar, white spruce, blue spruce, Amur maple.	Austrian pine, eastern white pine, green ash, hackberry.	Silver maple.
140---------- Spicer	---	Northern whitecedar, lilac, Siberian peashrub.	Bur oak, hackberry, white spruce, eastern redcedar.	Golden willow, honeylocust, green ash.	Eastern cottonwood.
141A, 141B-------- Egeland	---	Rocky Mountain juniper, eastern redcedar, American plum, Siberian peashrub, lilac.	Green ash, hackberry, ponderosa pine, Russian olive, Manchurian crabapple.	Siberian elm------	---
149B, 149B2, 149C2---------- Everly	---	American plum, lilac, Siberian peashrub, cotoneaster.	Russian olive, eastern redcedar, blue spruce, hackberry, bur oak.	Green ash, ponderosa pine, honeylocust.	---
184---------- Hamerly	---	Redosier dogwood, ponderosa pine, Siberian peashrub, Peking cotoneaster, eastern redcedar, American plum, common chokecherry.	Green ash, Black Hills spruce.	Golden willow-----	Eastern cottonwood.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
210---------- Fulda	---	Common chokecherry, hedge cotoneaster, redosier dogwood.	Austrian pine, hackberry, Norway spruce, ponderosa pine.	Golden willow, green ash, thornless honeylocust.	Eastern cottonwood, silver maple.
211---------- Lura	---	Redosier dogwood	Black ash, tall purple willow.	Black willow, white willow, golden willow.	---
212---------- Sinai	Peking cotoneaster.	Manchurian crabapple, lilac, American plum, Siberian peashrub.	Austrian pine, ponderosa pine, hackberry, Russian olive, eastern redcedar.	Siberian elm, green ash.	---
219---------- Rolfe	---	Redosier dogwood, American plum.	Amur maple, northern whitecedar, hackberry, tall purple willow, white spruce.	Golden willow, green ash.	Silver maple, eastern cottonwood.
229---------- Waldorf	---	Redosier dogwood, American plum.	Northern whitecedar, white spruce, Amur maple, tall purple willow, hackberry.	Golden willow, green ash.	Eastern cottonwood, silver maple.
236---------- Vallers	---	Lilac, Siberian peashrub, common chokecherry, eastern redcedar.	White spruce, bur oak, Russian olive, blue spruce.	Golden willow, Siberian elm.	Eastern cottonwood.
241---------- Letri	---	Redosier dogwood, American plum.	Tall purple willow, hackberry, white spruce, northern whitecedar, Amur maple.	Green ash, golden willow.	Eastern cottonwood, silver maple.
246---------- Marysland	Redosier dogwood	Siberian peashrub, common chokecherry, eastern redcedar, lilac.	White spruce, Russian olive, green ash, Black Hills spruce.	Golden willow-----	Eastern cottonwood, Siberian elm.
276---------- Oldham	Lilac, silver buffaloberry.	Cotoneaster, Siberian peashrub.	Hackberry, blue spruce, ponderosa pine, Manchurian crabapple, eastern redcedar.	Golden willow, green ash.	Eastern cottonwood.
284B, 284B2------- Poinsett	---	Eastern redcedar, Siberian peashrub, American plum, lilac.	Hackberry, bur oak, blue spruce, ponderosa pine, Russian olive, Siberian crabapple.	Green ash---------	Siberian elm.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
297B, 297B2--- Vienna	---	Eastern redcedar, Siberian peashrub, American plum, lilac.	Hackberry, bur oak, blue spruce, ponderosa pine, Russian olive, Manchurian crabapple.	Green ash---	Siberian elm.
339A, 339B--- Fordville	Lilac---	Russian olive, Siberian crabapple, eastern redcedar, common chokecherry.	Honeylocust, green ash, ponderosa pine, Austrian pine, bur oak.	Siberian elm---	---
341A, 341B, 341C-- Arvilla	Lilac---	Russian olive, Siberian crabapple, eastern redcedar, Siberian peashrub, common chokecherry, American plum.	Honeylocust, green ash, ponderosa pine, Austrian pine, bur oak.	Siberian elm---	---
344--- Quam	---	Black spruce, redosier dogwood.	Tamarack, black ash, tall purple willow.	Golden willow, black willow, white willow.	---
345--- Wilmonton	---	Lilac, redosier dogwood.	Amur maple, blue spruce, white spruce, northern whitecedar.	Hackberry, green ash, eastern white pine, Austrian pine.	Silver maple.
359. Lamoure					
392--- Biscay	---	Redosier dogwood, American plum, cotoneaster.	Northern whitecedar, Amur maple, white spruce, hackberry, tall purple willow.	Green ash, golden willow.	Eastern cottonwood, silver maple.
402E. Sioux					
418--- Lamoure	Silver buffaloberry, lilac.	Siberian peashrub	Hackberry, blue spruce, ponderosa pine, Manchurian crabapple, eastern redcedar.	Golden willow, green ash.	Eastern cottonwood.
436--- Hidewood	---	American plum, redosier dogwood, cotoneaster, lilac, Siberian peashrub, common chokecherry.	White spruce, blue spruce, Manchurian crabapple.	Golden willow---	Carolina poplar, eastern cottonwood.
437F. Buse					

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
470---------- Lismore	---	Siberian peashrub, American plum, lilac.	Ponderosa pine, blue spruce, Manchurian crabapple, eastern redcedar.	Golden willow, green ash, hackberry.	Eastern cottonwood, Siberian elm.
506---------- Overly	---	Siberian peashrub, American plum, lilac.	Ponderosa pine, blue spruce, Siberian crabapple, eastern redcedar.	Golden willow, green ash, hackberry.	Eastern cottonwood, Siberian elm.
562---------- Knoke	---	Siberian peashrub, cotoneaster, lilac, northern whitecedar.	White spruce, bur oak, eastern redcedar, hackberry.	Honeylocust, golden willow, green ash.	Eastern cottonwood.
590---------- Moines	---	Siberian peashrub, lilac, northern whitecedar.	Hackberry, eastern redcedar, bur oak, white spruce.	Golden willow, honeylocust, green ash.	Eastern cottonwood.
594---------- Jeffers	---	Lilac, northern whitecedar, cotoneaster, Siberian peashrub.	Eastern redcedar, hackberry, bur oak, white spruce.	Honeylocust, green ash, golden willow.	Eastern cottonwood.
894D2*:					
Storden----------	American plum-----	Eastern redcedar, hackberry, Siberian peashrub.	Honeylocust, green ash, Russian olive.	Siberian elm------	---
Everly----------	---	Redosier dogwood, Siberian peashrub, gray dogwood, lilac.	Blue spruce, Russian olive, eastern redcedar, Amur maple, hackberry, northern whitecedar.	Green ash, eastern white pine.	---
902C2*:					
Barnes----------	---	Eastern redcedar, Siberian peashrub, American plum, lilac.	Blue spruce, ponderosa pine, Russian olive, Siberian crabapple, bur oak.	Green ash, honeylocust.	Siberian elm.
Buse----------	---	Eastern redcedar, Siberian peashrub, cotoneaster, Russian olive, lilac.	Green ash, bur oak	Siberian elm------	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
904B*, 904C*:					
Arvilla	Lilac	Russian olive, Siberian crabapple, eastern redcedar, Siberian peashrub, common chokecherry, American plum.	Honeylocust, green ash, ponderosa pine, Austrian pine, bur oak.	Siberian elm	---
Barnes	---	Eastern redcedar, Siberian peashrub, American plum, lilac.	Blue spruce, ponderosa pine, Russian olive, Siberian crabapple, bur oak.	Green ash, honeylocust.	Siberian elm.
Buse	---	Eastern redcedar, Siberian peashrub, cotoneaster, Russian olive, lilac.	Green ash, bur oak	Siberian elm	---
913D*:					
Buse	---	Eastern redcedar, Siberian peashrub, cotoneaster, Russian olive, lilac.	Green ash, bur oak	Siberian elm	---
Barnes	---	Eastern redcedar, Siberian peashrub, American plum, lilac.	Blue spruce, ponderosa pine, Russian olive, Siberian crabapple, bur oak.	Green ash, honeylocust.	Siberian elm.
917D*:					
Buse	---	Eastern redcedar, Siberian peashrub, cotoneaster, Russian olive, lilac.	Green ash, bur oak	Siberian elm	---
Sioux.					
918D*:					
Buse	---	Eastern redcedar, Siberian peashrub, cotoneaster, Russian olive, lilac.	Green ash, bur oak.	Siberian elm	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
918D*:					
Vienna	---	Eastern redcedar, Siberian peashrub, American plum, lilac.	Hackberry, bur oak, blue spruce, ponderosa pine, Russian olive, Manchurian crabapple.	Green ash	Siberian elm.
920C2*:					
Storden	American plum	Eastern redcedar, hackberry, Siberian peashrub.	Honeylocust, green ash, Russian olive.	Siberian elm	---
Clarion	---	Gray dogwood, redosier dogwood, lilac, Siberian peashrub.	Northern whitecedar, blue spruce, Amur maple, Russian olive, eastern redcedar, hackberry.	Green ash, eastern white pine.	---
Arvilla	Lilac	Russian olive, Siberian crabapple, eastern redcedar, Siberian peashrub, common chokecherry, American plum.	Honeylocust, green ash, ponderosa pine, Austrian pine, bur oak.	Siberian elm	---
921C2*:					
Clarion	---	Gray dogwood, redosier dogwood, lilac, Siberian peashrub.	Northern whitecedar, blue spruce, Amur maple, Russian olive, eastern redcedar, hackberry.	Green ash, eastern white pine.	---
Storden	American plum	Eastern redcedar, hackberry, Siberian peashrub.	Honeylocust, green ash, Russian olive.	Siberian elm	---
960D2*:					
Storden	American plum	Eastern redcedar, hackberry, Siberian peashrub.	Honeylocust, green ash, Russian olive.	Siberian elm	---
Clarion	---	Gray dogwood, redosier dogwood, lilac, Siberian peashrub.	Northern whitecedar, blue spruce, Amur maple, Russian olive, eastern redcedar, hackberry.	Green ash, eastern white pine.	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
964C2*:					
Vienna	---	Eastern redcedar, Siberian peashrub, American plum, lilac.	Hackberry, bur oak, blue spruce, ponderosa pine, Russian olive, Manchurian crabapple.	Green ash	Siberian elm.
Buse	---	Eastern redcedar, Siberian peashrub, lilac, Russian olive.	Green ash, bur oak	Siberian elm	---
1030*:					
Pits.					
Udorthents.					
1051.					
Glencoe					
1824.					
Quam					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
31F Storden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
33B, 33B2 Barnes	Slight	Slight	Moderate: slope.	Slight	Slight.
36 Flom	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
51 La Prairie	Severe: flooding.	Slight	Moderate: flooding.	Slight	Moderate: flooding.
70 Svea	Slight	Slight	Moderate: slope, small stones.	Slight	Slight.
86 Canisteo	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
94B Terril	Slight	Slight	Moderate: slope.	Slight	Slight.
96A, 96B Collinwood	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.
102B, 102B2 Clarion	Slight	Slight	Moderate: slope.	Slight	Slight.
113 Webster	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
114 Glencoe	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
118 Crippin	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight	Slight.
127A Sverdrup	Slight	Slight	Slight	Slight	Moderate: droughty.
127B Sverdrup	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
127C Sverdrup	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: droughty, slope.
130 Nicollet	Slight	Slight	Moderate: slope.	Slight	Slight.
140 Spicer	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
141A Egeland	Slight	Slight	Slight	Slight	Moderate: droughty.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
141B---------- Egeland	Slight----------	Slight----------	Moderate: slope.	Slight----------	Moderate: droughty.
149B, 149B2---------- Everly	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight----------	Slight.
149C2---------- Everly	Moderate: slope, percs slowly.	Moderate: slope, percs slowly.	Severe: slope.	Slight----------	Moderate: slope.
184---------- Hamerly	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
210---------- Fulda	Severe: flooding, wetness, too clayey.	Severe: too clayey.	Severe: too clayey, wetness.	Severe: too clayey.	Severe: too clayey.
211---------- Lura	Severe: ponding, too clayey.	Severe: ponding, too clayey.	Severe: too clayey, ponding.	Severe: ponding, too clayey.	Severe: ponding, too clayey.
212---------- Sinai	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.	Moderate: too clayey.	Severe: too clayey.
219---------- Rolfe	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
229---------- Waldorf	Severe: wetness, too clayey.	Severe: wetness, too clayey.	Severe: too clayey, wetness.	Severe: wetness, too clayey.	Severe: wetness, too clayey.
236---------- Vallers	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
241---------- Letri	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
246---------- Marysland	Severe: flooding, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
276---------- Oldham	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
284B, 284B2---------- Poinsett	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
297B, 297B2---------- Vienna	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
339A---------- Fordville	Slight----------	Slight----------	Slight----------	Slight----------	Slight.
339B---------- Fordville	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
341A---------- Arvilla	Slight----------	Slight----------	Slight----------	Slight----------	Moderate: droughty.
341B---------- Arvilla	Slight----------	Slight----------	Moderate: slope.	Slight----------	Moderate: droughty.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
341C---------- Arvilla	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: droughty, slope.
344---------- Quam	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
345---------- Wilmonton	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: percs slowly.	Slight----------	Slight.
359---------- Lamoure	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.	Severe: wetness, flooding.
392---------- Biscay	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
402E---------- Sioux	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: droughty, slope.
418---------- Lamoure	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.
436---------- Hidewood	Severe: flooding, wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
437F---------- Buse	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
470---------- Lismore	Slight----------	Slight----------	Slight----------	Slight----------	Slight.
506---------- Overly	Slight----------	Slight----------	Moderate: slope.	Slight----------	Slight.
562---------- Knoke	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
590---------- Moines	Moderate: wetness, percs slowly, excess salt.	Moderate: wetness, excess salt, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness.	Moderate: excess salt, wetness.
594---------- Jeffers	Severe: wetness.	Moderate: wetness, percs slowly.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
894D2*:					
Storden----------	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Everly----------	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.
902C2*:					
Barnes----------	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight----------	Moderate: slope.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
902C2*:					
Buse	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
904B*:					
Arvilla	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
Barnes	Slight	Slight	Moderate: slope.	Slight	Slight.
Buse	Slight	Slight	Moderate: slope.	Slight	Slight.
904C*:					
Arvilla	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: droughty, slope.
Barnes	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Buse	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
913D*:					
Buse	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Barnes	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
917D*:					
Buse	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Sioux	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: droughty, slope.
918D*:					
Buse	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Vienna	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
920C2*:					
Storden	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Clarion	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Arvilla	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: droughty, slope.
921C2*:					
Clarion	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
921C2*: Storden	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
960D2*: Storden	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
Clarion	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.	Severe: slope.
964C2*: Vienna	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
Buse	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight	Moderate: slope.
1030*: Pits.					
Udorthents.					
1051 Glencoe	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
1824 Quam	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
31F---------- Storden	Poor	Fair	Good	Fair	Poor	---	Very poor.	Very poor.	Fair	Fair	Very poor.
33B, 33B2---------- Barnes	Good	Good	Good	Good	Good	Fair	Poor	Very poor.	Good	Good	Very poor.
36---------- Flom	Good	Good	Good	Fair	Fair	Fair	Good	Good	Good	Fair	Good.
51---------- La Prairie	Good	Good	Good	---	---	Good	Poor	Poor	Good	---	Poor.
70---------- Svea	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
86---------- Canisteo	Good	Good	Fair	Fair	Fair	---	Good	Good	Good	Fair	Good.
94B---------- Terril	Fair	Good	Good	Good	Good	---	Very poor.	Very poor.	Good	Good	Very poor.
96A, 96B---------- Collinwood	Fair	Fair	Fair	Good	Good	---	Poor	Fair	Fair	Good	Poor.
102B, 102B2-------- Clarion	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.
113---------- Webster	Good	Good	Good	Fair	Poor	---	Good	Good	Good	Fair	Good.
114---------- Glencoe	Good	Good	Fair	Fair	Fair	---	Good	Good	Good	Fair	Good.
118---------- Crippin	Good	Good	Good	Good	Fair	---	Fair	Poor	Good	Good	Poor.
127A, 127B--------- Sverdrup	Fair	Fair	Fair	Fair	Fair	---	Poor	Very poor.	Fair	Fair	Poor.
127C---------- Sverdrup	Fair	Fair	Fair	Fair	Fair	---	Very poor.	Very poor.	Fair	Fair	Very poor.
130---------- Nicollet	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor.
140---------- Spicer	Good	Good	Fair	Fair	Poor	---	Good	Good	Good	Fair	Good.
141A, 141B--------- Egeland	Fair	Fair	Good	Fair	Very poor.	Fair	Very poor.	Very poor.	Fair	---	Very poor.
149B, 149B2-------- Everly	Good	Good	Good	Good	Good	---	Poor	Very poor.	Good	Good	Very poor.
149C2---------- Everly	Fair	Good	Good	Good	Good	---	Very poor.	Very poor.	Good	Good	Very poor.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Hard-wood trees	Conif-erous plants	Shrubs	Wetland plants	Shallow water areas	Open-land wild-life	Wood-land wild-life	Wetland wild-life
184---------- Hamerly	Good	Good	Good	Good	Good	Fair	Fair	Poor	Good	Good	Poor.
210---------- Fulda	Fair	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Fair.
211---------- Lura	Poor	Poor	Poor	Poor	Poor	---	Good	Good	Poor	Poor	Good.
212---------- Sinai	Good	Fair	Good	Fair	Very poor.	---	Very poor.	Very poor.	Good	Very poor.	Poor.
219---------- Rolfe	Fair	Fair	Fair	Fair	Poor	---	Good	Good	Fair	Fair	Good.
229---------- Waldorf	Good	Good	Fair	Fair	Fair	---	Good	Good	Good	Fair	Good.
236---------- Vallers	Fair	Fair	Fair	Fair	Poor	Fair	Good	Good	Fair	Fair	Good.
241---------- Letri	Fair	Fair	Fair	Fair	Fair	---	Good	Good	Fair	Fair	Good.
246---------- Marysland	Good	Good	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good.
276---------- Oldham	Good	Good	Good	Poor	Poor	---	Good	Good	Good	Poor	Good.
284B, 284B2-------- Poinsett	Good	Good	Good	Good	Very poor.	---	Poor	Very poor.	Good	Very poor.	Very poor.
297B, 297B2-------- Vienna	Good	Good	Good	Good	Very poor.	---	Very poor.	Very poor.	Good	Very poor.	Very poor.
339A---------- Fordville	Good	Good	Good	Poor	Very poor.	Fair	Very poor.	Very poor.	Good	Very poor.	Very poor.
339B---------- Fordville	Good	Good	Good	Poor	Very poor.	Fair	Very poor.	Very poor.	Good	Very poor.	Very poor.
341A, 341B--------- Arvilla	Fair	Good	Fair	Fair	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.
341C---------- Arvilla	Poor	Fair	Fair	Fair	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.
344---------- Quam	Fair	Fair	Poor	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.
345---------- Wilmonton	Good	Good	Good	Good	Good	---	Poor	Poor	Good	Good	Poor.
359---------- Lamoure	Very poor.	Poor	Fair	Good	Good	Fair	Fair	Fair	Poor	Good	Fair.
392---------- Biscay	Good	Good	Good	Good	Fair	---	Good	Good	Good	Fair	Good.
402E---------- Sioux	Very poor.	Very poor.	Poor	Poor	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Hard-wood trees	Conif-erous plants	Shrubs	Wetland plants	Shallow water areas	Open-land wild-life	Wood-land wild-life	Wetland wild-life
418---------- Lamoure	Good	Good	Fair	Good	Good	Fair	Fair	Fair	Good	Good	Fair.
436---------- Hidewood	Fair	Good	Good	Good	Good	---	Fair	Fair	Good	---	Fair.
437F---------- Buse	Poor	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
470---------- Lismore	Good	Good	Good	Good	Very poor.	---	Very poor.	Very poor.	Good	Very poor.	Very poor.
506---------- Overly	Good	Good	Good	Good	Very poor.	---	Very poor.	Very poor.	Good	Very poor.	Very poor.
562---------- Knoke	Fair	Fair	Fair	Poor	Very poor.	---	Good	Good	Fair	Poor	Good.
590---------- Moines	Good	Good	Good	Fair	Fair	---	Poor	Poor	Good	Fair	Poor.
594---------- Jeffers	Good	Good	Good	Good	Fair	---	Good	Good	Good	Good	Good.
894D2*:											
Storden----------	Fair	Good	Good	Fair	Poor	---	Very poor.	Very poor.	Fair	Fair	Very poor.
Everly----------	Fair	Good	Good	Good	Good	---	Very poor.	Very poor.	Good	Good	Very poor.
902C2*:											
Barnes----------	Fair	Good	Good	Good	Good	Fair	Very poor.	Very poor.	Good	Good	Very poor.
Buse----------	Fair	Good	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
904B*:											
Arvilla----------	Fair	Good	Fair	Fair	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.
Barnes----------	Good	Good	Good	Good	Good	Fair	Poor	Very poor.	Good	Good	Very poor.
Buse----------	Good	Good	Fair	Fair	Fair	Fair	Poor	Very poor.	Good	Fair	Very poor.
904C*:											
Arvilla----------	Poor	Fair	Fair	Fair	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.
Barnes----------	Fair	Good	Good	Good	Good	Fair	Very poor.	Very poor.	Good	Good	Very poor.
Buse----------	Fair	Good	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
913D*:											
Buse	Fair	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Barnes	Poor	Fair	Good	Good	Good	Fair	Very poor.	Very poor.	Fair	Good	Very poor.
917D*:											
Buse	Fair	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Sioux	Very poor.	Very poor.	Poor	Poor	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.
918D*:											
Buse	Fair	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Vienna	Poor	Good	Good	Poor	Very poor.	---	Very poor.	Very poor.	Poor	Very poor.	Very poor.
920C2*:											
Storden	Fair	Good	Good	Fair	Poor	---	Very poor.	Very poor.	Fair	Fair	Very poor.
Clarion	Fair	Good	Good	Good	Good	---	Very poor.	Very poor.	Good	Good	Very poor.
Arvilla	Poor	Fair	Fair	Fair	Fair	Poor	Very poor.	Very poor.	Fair	Fair	Very poor.
921C2*:											
Clarion	Fair	Good	Good	Good	Good	---	Very poor.	Very poor.	Good	Good	Very poor.
Storden	Fair	Good	Good	Fair	Poor	---	Very poor.	Very poor.	Fair	Fair	Very poor.
960D2*:											
Storden	Fair	Good	Good	Fair	Poor	---	Very poor.	Very poor.	Fair	Fair	Very poor.
Clarion	Poor	Fair	Good	Good	Good	---	Very poor.	Very poor.	Fair	Good	Very poor.
964C2*:											
Vienna	Poor	Good	Good	Poor	Very poor.	---	Very poor.	Very poor.	Poor	Very poor.	Very poor.
Buse	Fair	Good	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
1051 Glencoe	Very poor.	Very poor.	Very poor.	Very poor.	Very poor.	---	Good	Good	Very poor.	Very poor.	Good.
1824 Quam	Very poor.	Poor	Very poor.	Very poor.	Very poor.	Very poor.	Good	Good	Very poor.	Very poor.	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
31F---------- Storden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
33B---------- Barnes	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: low strength, frost action.	Slight.
33B2---------- Barnes	Slight---------	Slight---------	Slight---------	Moderate: slope.	Moderate: low strength, frost action.	Slight.
36---------- Flom	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
51---------- La Prairie	Moderate: wetness, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding, low strength.	Moderate: flooding.
70---------- Svea	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
86---------- Canisteo	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
94B---------- Terril	Slight---------	Slight---------	Slight---------	Moderate: slope.	Severe: low strength.	Slight.
96A, 96B---------- Collinwood	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.
102B---------- Clarion	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: frost action.	Slight.
102B2---------- Clarion	Slight---------	Slight---------	Slight---------	Moderate: slope.	Moderate: frost action.	Slight.
113---------- Webster	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
114---------- Glencoe	Severe: ponding.	Severe: ponding, low strength.	Severe: ponding.	Severe: ponding, low strength.	Severe: ponding, low strength, frost action.	Severe: ponding.
118---------- Crippin	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action, low strength.	Slight.
127A---------- Sverdrup	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: droughty.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
127B---------- Sverdrup	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Moderate: droughty.
127C---------- Sverdrup	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
130---------- Nicollet	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
140---------- Spicer	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action, low strength.	Moderate: wetness.
141A---------- Egeland	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: droughty.
141B---------- Egeland	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Moderate: droughty.
149B---------- Everly	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
149B2---------- Everly	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: low strength.	Slight.
149C2---------- Everly	Moderate: slope.	Moderate: slope, shrink-swell.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
184---------- Hamerly	Moderate: wetness.	Slight---------	Moderate: wetness.	Slight---------	Severe: frost action.	Slight.
210---------- Fulda	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, frost action.	Severe: too clayey.
211---------- Lura	Severe: excess humus, ponding.	Severe: ponding, shrink-swell, low strength.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell, low strength.	Severe: shrink-swell, low strength, ponding.	Severe: ponding, too clayey.
212---------- Sinai	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.	Severe: too clayey.
219---------- Rolfe	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding.
229---------- Waldorf	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.	Severe: wetness, too clayey.
236---------- Vallers	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
241--Letri	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, wetness, frost action.	Severe: wetness.
246--Marysland	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: frost action.	Moderate: wetness.
276--Oldham	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: shrink-swell, low strength, ponding.	Severe: ponding.
284B--Poinsett	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: frost action, low strength.	Slight.
284B2--Poinsett	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: slope, shrink-swell.	Severe: frost action, low strength.	Slight.
297B--Vienna	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.	Slight.
297B2--Vienna	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.	Slight.
339A--Fordville	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Slight.
339B--Fordville	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Slight.
341A--Arvilla	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
341B--Arvilla	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
341C--Arvilla	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
344--Quam	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.
345--Wilmonton	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
359--Lamoure	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: wetness, flooding.
392--Biscay	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
402E---------- Sioux	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
418---------- Lamoure	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.	Severe: wetness.
436---------- Hidewood	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, frost action.	Moderate: wetness.
437F---------- Buse	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
470---------- Lismore	Moderate: wetness.	Moderate: shrink-swell.	Moderate: wetness, shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
506---------- Overly	Moderate: too clayey, wetness.	Moderate: shrink-swell.	Moderate: shrink-swell, wetness.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
562---------- Knoke	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, low strength, shrink-swell.	Severe: ponding.
590---------- Moines	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Moderate: excess salt, wetness.
594---------- Jeffers	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
894D2*:						
Storden----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Everly----------	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
902C2*:						
Barnes----------	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: low strength, slope, frost action.	Moderate: slope.
Buse----------	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: low strength, slope, frost action.	Moderate: slope.
904B*:						
Arvilla----------	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Moderate: droughty.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
904B*:						
Barnes	Slight	Slight	Slight	Moderate: slope.	Moderate: low strength, frost action.	Slight.
Buse	Slight	Slight	Slight	Moderate: slope.	Moderate: low strength, frost action.	Slight.
904C*:						
Arvilla	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.
Barnes	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: low strength, slope, frost action.	Moderate: slope.
Buse	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: low strength, slope, frost action.	Moderate: slope.
913D*:						
Buse	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Barnes	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
917D*:						
Buse	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Sioux	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: droughty, slope.
918D*:						
Buse	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Vienna	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
920C2*:						
Storden	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
Clarion	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
Arvilla	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: droughty, slope.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
921C2*:						
Clarion	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
Storden	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope, frost action.	Moderate: slope.
960D2*:						
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Clarion	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
964C2*:						
Vienna	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.	Moderate: slope.
Buse	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Moderate: low strength, slope, shrink-swell.	Moderate: slope.
1030*:						
Pits.						
Udorthents.						
1051 Glencoe	Severe: excess humus, ponding.	Severe: flooding, ponding, low strength.	Severe: flooding, ponding.	Severe: flooding, ponding, low strength.	Severe: low strength, ponding, frost action.	Severe: ponding.
1824 Quam	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: low strength, ponding, frost action.	Severe: ponding.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
31F---------- Storden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
33B, 33B2---------- Barnes	Moderate: percs slowly.	Moderate: seepage, slope.	Slight----------	Slight----------	Good.
36---------- Flom	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
51---------- La Prairie	Severe: flooding, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Good.
70---------- Svea	Severe: percs slowly.	Moderate: seepage, slope, wetness.	Severe: wetness.	Moderate: wetness.	Fair: too clayey.
86---------- Canisteo	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
94B---------- Terril	Slight----------	Moderate: seepage, slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
96A---------- Collinwood	Severe: wetness, percs slowly.	Slight----------	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
96B---------- Collinwood	Severe: wetness, percs slowly.	Moderate: slope.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack.
102B, 102B2--------- Clarion	Slight----------	Moderate: slope, seepage.	Slight----------	Slight----------	Good.
113---------- Webster	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
114---------- Glencoe	Severe: percs slowly, ponding.	Severe: ponding.	Severe: ponding, excess humus.	Severe: ponding.	Poor: ponding, hard to pack.
118---------- Crippin	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
127A, 127B---------- Sverdrup	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
127C---------- Sverdrup	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
130---------- Nicollet	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
140---------- Spicer	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
141A, 141B---------- Egeland	Slight----------	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: seepage.
149B, 149B2---------- Everly	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
149C2---------- Everly	Severe: percs slowly.	Severe: slope.	Moderate: too clayey, slope.	Moderate: slope.	Fair: too clayey, slope.
184---------- Hamerly	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
210---------- Fulda	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
211---------- Lura	Severe: ponding, percs slowly.	Slight----------	Severe: ponding, too clayey, excess humus.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
212---------- Sinai	Severe: percs slowly.	Slight----------	Severe: too clayey.	Slight----------	Poor: too clayey, hard to pack.
219---------- Rolfe	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
229---------- Waldorf	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey, hard to pack, wetness.
236---------- Vallers	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
241---------- Letri	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
246---------- Marysland	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
276---------- Oldham	Severe: ponding, percs slowly.	Slight----------	Severe: ponding.	Severe: ponding.	Poor: hard to pack, ponding.
284B, 284B2---------- Poinsett	Moderate: percs slowly.	Moderate: slope, seepage.	Slight----------	Slight----------	Good.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
297B, 297B2--------- Vienna	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight----------	Fair: too clayey.
339A, 339B--------- Fordville	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: small stones, too sandy, seepage.
341A, 341B--------- Arvilla	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
341C--------- Arvilla	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
344--------- Quam	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.
345--------- Wilmonton	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
359--------- Lamoure	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
392--------- Biscay	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
402E--------- Sioux	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
418--------- Lamoure	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: hard to pack, wetness.
436--------- Hidewood	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
437F--------- Buse	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
470--------- Lismore	Severe: percs slowly.	Slight----------	Moderate: too clayey.	Slight----------	Fair: too clayey.
506--------- Overly	Severe: percs slowly.	Moderate: slope, wetness.	Severe: wetness.	Moderate: wetness.	Poor: thin layer.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
562 Knoke	Severe: percs slowly, ponding.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: ponding, too clayey, hard to pack.
590 Moines	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
594 Jeffers	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
894D2*: Storden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Everly	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
902C2*: Barnes	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Buse	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
904B*: Arvilla	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Barnes	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
Buse	Moderate: percs slowly.	Moderate: seepage, slope.	Slight	Slight	Good.
904C*: Arvilla	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Barnes	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Buse	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
913D*: Buse	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
913D*:					
Barnes	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
917D*:					
Buse	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Sioux	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, small stones.
918D*:					
Buse	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Vienna	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
920C2*:					
Storden	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Clarion	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Arvilla	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
921C2*:					
Clarion	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
Storden	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
960D2*:					
Storden	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Clarion	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
964C2*:					
Vienna	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Buse	Severe: percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
1030*:					
Pits.					
Udorthents.					

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1051---------- Glencoe	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, excess humus.	Severe: ponding.	Poor: hard to pack, ponding.
1824---------- Quam	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding.	Severe: ponding.	Poor: ponding.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
31F Storden	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
33B, 33B2 Barnes	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
36 Flom	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
51 La Prairie	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
70 Svea	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
86 Canisteo	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
94B Terril	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
96A, 96B Collinwood	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
102B, 102B2 Clarion	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
113 Webster	Fair: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
114 Glencoe	Poor: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
118 Crippin	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
127A, 127B, 127C Sverdrup	Good	Probable	Improbable: too sandy.	Poor: too sandy.
130 Nicollet	Fair: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
140 Spicer	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
141A, 141B Egeland	Good	Probable	Improbable: too sandy.	Good.
149B, 149B2 Everly	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
149C2---------- Everly	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope.
184---------- Hamerly	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
210---------- Fulda	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
211---------- Lura	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, too clayey.
212---------- Sinai	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
219---------- Rolfe	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
229---------- Waldorf	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
236---------- Vallers	Fair: wetness, low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
241---------- Letri	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
246---------- Marysland	Fair: wetness.	Probable----------	Probable----------	Fair: area reclaim, small stones, thin layer.
276---------- Oldham	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
284B, 284B2---------- Poinsett	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
297B, 297B2---------- Vienna	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
339A, 339B---------- Fordville	Good----------	Probable----------	Probable----------	Fair: thin layer.
341A, 341B, 341C------ Arvilla	Good----------	Probable----------	Probable----------	Poor: too sandy, small stones, area reclaim.
344---------- Quam	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
345---------- Wilmonton	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
359---------- Lamoure	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
392---------- Biscay	Fair: wetness.	Probable----------	Probable----------	Poor: area reclaim.
402E---------- Sioux	Fair: slope.	Probable----------	Probable----------	Poor: small stones, area reclaim, slope.
418---------- Lamoure	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
436---------- Hidewood	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones.
437F---------- Buse	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
470---------- Lismore	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
506---------- Overly	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
562---------- Knoke	Poor: wetness, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
590---------- Moines	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, excess salt.
594---------- Jeffers	Fair: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
894D2*:				
Storden----------	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Everly----------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
902C2*:				
Barnes----------	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
902C2*:				
Buse	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, small stones.
904B*:				
Arvilla	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
Barnes	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Buse	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
904C*:				
Arvilla	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
Barnes	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
Buse	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, small stones.
913D*:				
Buse	Fair: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Barnes	Fair: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
917D*:				
Buse	Fair: low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Sioux	Fair: slope.	Probable	Probable	Poor: small stones, area reclaim, slope.
918D*:				
Buse	Fair: low strength, slope, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Vienna	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
920C2*:				
Storden	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
Clarion	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Arvilla	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
921C2*:				
Clarion	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
Storden	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
960D2*:				
Storden	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Clarion	Fair: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
964C2*:				
Vienna	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
Buse	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones, slope.
1030*: Pits. Udorthents.				
1051 Glencoe	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
1824 Quam	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
31F---------- Storden	Severe: slope.	Moderate: piping.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
33B, 33B2--------- Barnes	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope----------	Erodes easily	Erodes easily.
36---------- Flom	Slight---------	Severe: wetness.	Frost action---	Wetness--------	Wetness--------	Wetness.
51---------- La Prairie	Moderate: seepage.	Severe: piping.	Deep to water	Flooding-------	Favorable------	Favorable.
70---------- Svea	Moderate: seepage.	Severe: piping.	Deep to water	Favorable------	Erodes easily	Erodes easily.
86---------- Canisteo	Moderate: seepage.	Severe: wetness.	Frost action---	Wetness--------	Wetness--------	Wetness.
94B---------- Terril	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope----------	Favorable------	Favorable.
96A---------- Collinwood	Slight---------	Moderate: hard to pack, wetness.	Percs slowly, frost action.	Wetness, slow intake.	Wetness, percs slowly.	Percs slowly.
96B---------- Collinwood	Moderate: slope.	Moderate: hard to pack, wetness.	Percs slowly, frost action, slope.	Slope, wetness, slow intake.	Wetness, percs slowly.	Percs slowly.
102B, 102B2------- Clarion	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope----------	Erodes easily	Erodes easily.
113---------- Webster	Moderate: seepage.	Severe: wetness.	Frost action---	Wetness--------	Wetness--------	Wetness.
114---------- Glencoe	Moderate: seepage.	Severe: hard to pack, excess humus, ponding.	Frost action, ponding.	Ponding--------	Ponding--------	Wetness.
118---------- Crippin	Moderate: seepage.	Moderate: wetness, piping.	Frost action---	Wetness--------	Wetness, erodes easily.	Erodes easily.
127A---------- Sverdrup	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
127B---------- Sverdrup	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, soil blowing.	Too sandy, soil blowing.	Droughty.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
127C--Sverdrup	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
130--Nicollet	Moderate: seepage.	Moderate: piping.	Frost action	Wetness	Wetness	Favorable.
140--Spicer	Moderate: seepage.	Severe: wetness.	Frost action	Wetness	Wetness, erodes easily.	Wetness, erodes easily.
141A--Egeland	Severe: seepage.	Severe: piping, seepage.	Deep to water	Soil blowing, droughty.	Soil blowing, too sandy.	Droughty.
141B--Egeland	Severe: seepage.	Severe: piping, seepage.	Deep to water	Soil blowing, slope, droughty.	Soil blowing, too sandy.	Droughty.
149B, 149B2--Everly	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope	Favorable	Favorable.
149C2--Everly	Severe: slope.	Moderate: piping.	Deep to water	Slope	Slope	Slope.
184--Hamerly	Moderate: seepage.	Severe: piping.	Frost action	Wetness	Erodes easily, wetness.	Erodes easily.
210--Fulda	Slight	Severe: hard to pack, wetness.	Percs slowly, frost action.	Wetness, slow intake, percs slowly.	Wetness	Wetness, percs slowly.
211--Lura	Slight	Severe: excess humus, hard to pack, ponding.	Ponding, percs slowly, frost action.	Ponding, slow intake, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
212--Sinai	Slight	Moderate: hard to pack.	Deep to water	Slow intake, percs slowly.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
219--Rolfe	Moderate: seepage.	Severe: ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Ponding	Wetness, percs slowly.
229--Waldorf	Moderate: seepage.	Severe: hard to pack, wetness.	Frost action	Wetness, slow intake.	Wetness	Wetness.
236--Vallers	Slight	Severe: wetness.	Frost action	Wetness	Wetness	Wetness.
241--Letri	Moderate: seepage.	Severe: piping, wetness.	Frost action	Wetness	Wetness	Wetness.
246--Marysland	Severe: seepage.	Severe: seepage, wetness.	Frost action, cutbanks cave.	Wetness	Wetness, too sandy.	Wetness.
276--Oldham	Slight	Severe: hard to pack, ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
284B, 284B2---- Poinsett	Moderate: seepage, slope.	Moderate: thin layer, piping.	Deep to water	Slope----------	Erodes easily	Erodes easily.
297B, 297B2---- Vienna	Moderate: slope.	Slight---------	Deep to water	Slope----------	Erodes easily	Erodes easily.
339A---------- Fordville	Severe: seepage.	Severe: seepage.	Deep to water	Favorable------	Too sandy------	Favorable.
339B---------- Fordville	Severe: seepage.	Severe: seepage.	Deep to water	Slope----------	Too sandy------	Favorable.
341A---------- Arvilla	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
341B---------- Arvilla	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
341C---------- Arvilla	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
344---------- Quam	Slight---------	Severe: piping, ponding.	Ponding, frost action.	Ponding--------	Ponding--------	Wetness, erodes easily.
345---------- Wilmonton	Slight---------	Moderate: piping, wetness.	Frost action---	Wetness--------	Erodes easily, wetness.	Erodes easily.
359---------- Lamoure	Moderate: seepage.	Severe: hard to pack, wetness.	Flooding, frost action.	Wetness, flooding.	Wetness--------	Wetness.
392---------- Biscay	Severe: seepage.	Severe: seepage, wetness.	Frost action, cutbanks cave.	Wetness--------	Wetness, too sandy.	Wetness.
402E---------- Sioux	Severe: seepage, slope.	Severe: seepage.	Deep to water	Slope, droughty, soil blowing.	Slope, too sandy, soil blowing.	Droughty, slope.
418---------- Lamoure	Moderate: seepage.	Severe: hard to pack, wetness.	Flooding, frost action.	Wetness, flooding.	Wetness--------	Wetness.
436---------- Hidewood	Moderate: seepage.	Moderate: piping, wetness.	Frost action---	Wetness--------	Wetness--------	Wetness.
437F---------- Buse	Severe: slope.	Moderate: piping.	Deep to water	Slope----------	Slope, erodes easily.	Slope, erodes easily.
470---------- Lismore	Slight---------	Slight---------	Deep to water	Favorable------	Erodes easily	Erodes easily.
506---------- Overly	Slight---------	Severe: piping.	Deep to water	Percs slowly---	Favorable------	Percs slowly.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
562 Knoke	Slight	Severe: hard to pack, ponding.	Ponding, frost action.	Ponding	Ponding, erodes easily.	Wetness, erodes easily.
590 Moines	Moderate: seepage.	Severe: piping, wetness.	Frost action	Wetness, rooting depth.	Erodes easily, wetness.	Excess salt, erodes easily, rooting depth.
594 Jeffers	Moderate: seepage.	Severe: wetness.	Frost action	Wetness	Wetness	Wetness.
894D2*:						
Storden	Severe: slope.	Moderate: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Everly	Severe: slope.	Moderate: piping.	Deep to water	Slope	Slope	Slope.
902C2*:						
Barnes	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Buse	Severe: slope.	Moderate: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
904B*:						
Arvilla	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
Barnes	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
Buse	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
904C*:						
Arvilla	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
Barnes	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Buse	Severe: slope.	Moderate: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
913D*:						
Buse	Severe: slope.	Moderate: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Barnes	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
917D*:						
Buse	Severe: slope.	Moderate: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
917D*:						
Sioux	Severe: seepage, slope.	Severe: seepage.	Deep to water	Slope, droughty, soil blowing.	Slope, too sandy, soil blowing.	Droughty, slope.
918D*:						
Buse	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Vienna	Severe: slope.	Slight	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
920C2*:						
Storden	Severe: slope.	Moderate: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Clarion	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Arvilla	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
921C2*:						
Clarion	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Storden	Severe: slope.	Moderate: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
960D2*:						
Storden	Severe: slope.	Moderate: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Clarion	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
964C2*:						
Vienna	Severe: slope.	Slight	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
Buse	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope, erodes easily.	Slope, erodes easily.
1030*:						
Pits.						
Udorthents.						
1051 Glencoe	Moderate: seepage.	Severe: excess humus, hard to pack, ponding.	Ponding, frost action.	Ponding	Ponding	Wetness.
1824 Quam	Slight	Severe: piping, ponding.	Ponding, frost action.	Ponding	Ponding	Wetness, erodes easily.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
31F----------	0-9	Loam----------	ML, CL	A-4, A-6	0-5	95-100	95-100	70-85	55-70	30-40	5-15
Storden	9-60	Loam, clay loam	CL-ML, CL, ML	A-4, A-6	0-5	95-100	85-97	70-85	55-70	20-40	5-15
33B, 33B2--------	0-9	Loam----------	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	80-100	50-90	20-40	5-20
Barnes	9-17	Loam, clay loam	CL, CL-ML, SC, SM-SC	A-4, A-6	0-5	90-100	85-100	75-95	50-80	25-40	5-20
	17-60	Loam----------	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
36----------	0-23	Clay loam--------	CL	A-6, A-7	0	95-100	95-100	80-100	60-90	30-50	10-20
Flom	23-33	Clay loam, silty clay loam, loam.	CL	A-6, A-7	0	95-100	95-100	90-100	70-95	30-50	10-30
	33-60	Loam, clay loam	CL	A-6, A-7	0	95-100	90-100	80-95	60-90	20-50	10-30
51----------	0-13	Loam----------	CL-ML, CL	A-4, A-6	0	100	100	85-95	70-80	25-40	5-15
La Prairie	13-36	Silt loam, loam, silty clay loam.	CL-ML, CL	A-4, A-6, A-7	0	100	100	85-100	50-80	25-45	5-25
	36-60	Stratified fine sandy loam to silty clay loam.	CL-ML, CL, SC, SM-SC	A-4, A-6, A-7	0	100	95-100	75-100	45-80	25-45	5-25
70----------	0-8	Loam----------	CL, CL-ML	A-4, A-6	0-5	95-100	85-100	80-95	60-90	20-40	5-20
Svea	8-26	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-95	60-90	20-45	5-25
	26-60	Loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	85-100	80-95	60-85	20-50	5-30
86----------	0-17	Clay loam--------	OL, CL	A-7	0	95-100	95-100	85-100	60-100	40-50	15-20
Canisteo	17-23	Clay loam, loam, silty clay loam.	CL	A-6, A-7	0	98-100	90-100	85-95	65-85	38-50	25-35
	23-36	Clay loam, loam, sandy loam.	CL, ML, SM, SC	A-6, A-4	0-5	90-100	80-95	60-90	40-80	30-40	5-15
	36-60	Clay loam, loam	CL	A-6	0-5	95-100	90-98	80-95	50-75	30-40	12-20
94B----------	0-35	Loam----------	CL	A-6	0-5	95-100	95-100	70-90	60-80	30-40	10-20
Terril	35-60	Clay loam, loam	CL, SC, CL-ML	A-6, A-4	0-5	95-100	90-100	70-95	50-85	20-40	5-20
96A, 96B---------	0-18	Silty clay-------	CL, CH, ML, MH	A-7	0	100	100	95-100	90-95	40-55	15-25
Collinwood	18-34	Silty clay, clay, silty clay loam.	MH, CH	A-7	0	100	100	95-100	90-95	50-65	20-35
	34-60	Silty clay, clay, silty clay loam.	CH, CL	A-7	0	100	100	95-100	90-95	40-60	15-30
102B, 102B2------	0-12	Loam----------	CL, CL-ML	A-4, A-6	0-5	95-100	95-100	75-90	50-75	25-40	5-15
Clarion	12-23	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-90	50-75	25-40	5-15
	23-60	Loam, sandy loam	CL, CL-ML, SC, SM-SC	A-4, A-6	0-5	90-100	85-100	75-90	45-70	25-40	5-15
113----------	0-20	Clay loam--------	CL, CH	A-7, A-6	0-5	95-100	95-100	85-95	70-90	35-60	15-30
Webster	20-30	Clay loam, silty clay loam, loam.	CL	A-6, A-7	0-5	95-100	95-100	85-95	60-80	35-50	15-30
	30-60	Loam, sandy loam, clay loam.	CL	A-6	0-5	95-100	90-100	75-85	50-75	30-40	10-20

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
114--------- Glencoe	0-33	Silty clay loam	OL, OH, MH, ML	A-6, A-7	0	95-100	90-100	75-100	60-90	30-55	10-25
	33-46	Loam, clay loam, silty clay loam.	CL	A-6, A-7	0	95-100	90-100	75-100	60-90	30-50	10-25
	46-60	Loam, clay loam	CL, ML	A-6, A-7	0	90-100	85-100	60-95	55-75	30-50	10-20
118--------- Crippin	0-17	Loam---------	CL	A-6, A-7	0	95-100	95-100	80-90	60-80	30-45	10-20
	17-35	Loam, clay loam	CL	A-6	0-5	95-100	90-100	80-90	60-80	30-40	10-20
	35-60	Loam, clay loam	CL	A-6	2-5	90-100	85-100	75-90	55-80	30-40	10-20
127A, 127B, 127C- Sverdrup	0-15	Sandy loam-------	SM	A-4	0	100	95-100	60-70	35-50	---	NP
	15-28	Loam, sandy loam, loamy sand.	ML, SM	A-2, A-4	0	100	95-100	50-75	30-70	<30	NP-5
	28-60	Sand, fine sand	SP, SP-SM	A-3, A-2	0	100	95-100	50-90	2-10	---	NP
130--------- Nicollet	0-16	Loam---------	ML, CL	A-6, A-7	0-5	95-100	90-100	85-100	55-85	30-45	10-25
	16-28	Clay loam, loam	CL	A-6, A-7	0-5	95-100	90-100	80-95	55-80	35-50	15-25
	28-60	Loam, clay loam	CL	A-6	0-5	95-100	90-100	75-90	50-75	30-40	15-25
140--------- Spicer	0-14	Silty clay loam	ML	A-7, A-6	0	100	100	95-100	90-100	35-50	10-20
	14-31	Silt loam, silty clay loam.	ML	A-7, A-6	0	100	100	95-100	85-100	35-50	10-20
	31-60	Silt loam, silty clay loam.	ML	A-4, A-6	0	100	100	95-100	85-100	30-40	5-12
141A, 141B------- Egeland	0-9	Sandy loam-------	SM, SM-SC	A-2, A-4	0	100	95-100	75-100	30-50	<30	NP-7
	9-26	Sandy loam, fine sandy loam.	SM, SM-SC	A-2, A-4	0	95-100	85-100	70-100	15-50	<30	NP-7
	26-60	Loamy sand, loamy fine sand, sand.	SM, SP-SM, SM-SC	A-2, A-4	0	95-100	85-100	70-100	10-45	<25	NP-5
149B, 149B2, 149C2---------- Everly	0-13	Clay loam--------	CL	A-6, A-7	0	100	95-100	85-95	65-80	30-45	10-20
	13-21	Clay loam, loam	CL	A-6, A-7	0	95-100	95-100	85-95	70-90	35-50	15-25
	21-60	Loam, clay loam	CL	A-6	0-5	90-100	85-95	75-85	60-80	30-40	10-20
184--------- Hamerly	0-8	Loam---------	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	60-90	20-40	5-20
	8-20	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	60-75	20-40	5-20
	20-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	95-100	90-100	80-95	60-75	20-40	5-20
210--------- Fulda	0-16	Silty clay-------	OH, CH, CL, MH	A-7	0	100	100	95-100	85-95	40-70	20-35
	16-41	Silty clay, clay, silty clay loam.	CH, CL	A-7	0	100	100	90-100	90-95	45-70	25-50
	41-60	Silty clay loam, silty clay, clay loam.	CH, CL, MH, ML	A-7	0	100	90-100	90-100	85-95	40-70	15-30
211--------- Lura	0-41	Silty clay-------	CH, OH	A-7	0	100	100	95-100	90-100	50-75	25-45
	41-60	Silty clay, silty clay loam.	CL, CH	A-7	0	100	100	95-100	90-100	40-75	15-45
212--------- Sinai	0-17	Silty clay-------	CL, CH, MH, ML	A-7	0	100	100	95-100	90-100	45-70	20-35
	17-30	Silty clay, silty clay loam, clay.	CL, CH, MH, ML	A-7	0	100	100	95-100	90-100	45-70	20-35
	30-60	Stratified silty clay to silt loam.	CL, CH	A-7	0	100	100	95-100	80-95	40-65	15-35

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
219---------- Rolfe	0-20	Silt loam--------	OL, CL, ML	A-6, A-4	0	100	95-100	90-100	80-95	30-40	5-15
	20-36	Silty clay, silty clay loam, clay loam.	CH	A-7	0	100	95-100	90-100	75-95	50-65	25-35
	36-60	Clay loam, loam	CL	A-7, A-6	0	95-100	90-100	80-90	55-75	30-45	10-20
229---------- Waldorf	0-21	Silty clay-------	ML, MH	A-7	0	100	100	95-100	90-100	45-65	14-30
	21-42	Silty clay, silty clay loam, clay.	MH	A-7	0	100	100	95-100	95-100	50-70	20-35
	42-60	Silty clay loam, silty clay, silt loam.	MH, CL, ML, CH	A-7, A-6	0	100	100	95-100	90-100	35-65	11-30
236---------- Vallers	0-15	Clay loam--------	OL, CL, ML	A-6, A-7	0	95-100	95-100	95-100	85-95	30-50	11-20
	15-23	Clay loam, silty clay loam, sandy clay loam.	CL	A-6	0	95-100	90-100	80-95	50-80	30-40	11-20
	23-60	Loam, clay loam	CL, CL-ML	A-4, A-6	0	95-100	90-100	85-95	60-85	20-40	5-20
241---------- Letri	0-20	Clay loam--------	CL	A-7	0	95-100	95-100	95-100	80-95	40-50	15-25
	20-34	Clay loam, silty clay loam.	CL	A-7	0	95-100	90-100	85-95	75-85	40-50	15-25
	34-60	Loam, clay loam	CL, ML	A-6, A-7, A-4	0-5	95-100	85-100	85-95	65-75	30-50	7-25
246---------- Marysland	0-17	Loam-------------	CL	A-6, A-7	0	95-100	95-100	85-95	50-80	30-50	10-25
	17-27	Loam, clay loam, sandy clay loam.	CL, SC	A-6	0	90-100	85-100	80-95	45-80	20-40	10-20
	27-60	Stratified fine sand to gravelly coarse sand.	SP-SM, SM	A-1, A-2, A-3	0	70-95	50-90	35-70	5-20	---	NP
276---------- Oldham	0-40	Silty clay loam	CL, CH, MH, ML	A-7	0	100	95-100	90-100	85-100	40-60	15-25
	40-60	Silty clay loam, silt loam, clay loam.	CL, CL-ML	A-4, A-6, A-7	0	100	95-100	85-100	70-100	25-45	5-20
284B, 284B2------ Poinsett	0-9	Silty clay loam	CL, ML	A-6, A-7	0	100	100	95-100	85-100	35-50	10-25
	9-29	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	95-100	95-100	75-100	30-50	10-25
	29-60	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	95-100	95-100	75-100	30-50	10-25
297B, 297B2------ Vienna	0-10	Silty clay loam	ML, CL	A-6, A-7	0	100	100	95-100	85-100	35-50	10-25
	10-15	Silty clay loam, silt loam.	ML, CL	A-6, A-7	0	100	95-100	90-100	85-100	35-50	10-25
	15-26	Clay loam, loam	CL	A-6, A-7	0-5	95-100	90-100	85-100	60-85	30-45	10-20
	26-60	Clay loam, loam	CL	A-6	0-5	90-100	85-100	80-100	55-80	30-40	10-20
339A, 339B------- Fordville	0-7	Loam-------------	ML, CL	A-4, A-6, A-7	0	100	100	70-85	55-75	30-45	5-20
	7-15	Loam, silt loam, clay loam.	CL, ML	A-4, A-6, A-7	0	100	95-100	70-95	55-80	30-45	5-20
	15-27	Loam, clay loam, sandy clay loam.	CL, ML, SM, SC	A-4, A-6	0	95-100	90-100	65-90	40-55	25-40	3-15
	27-60	Gravelly loamy sand, gravelly sand, very gravelly sand.	SW, SW-SM, SM	A-1	0	65-85	45-70	15-45	0-15	<25	NP-5

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
341A, 341B, 341C-Arvilla	0-8	Sandy loam-------	SM, SC, SM-SC	A-2, A-4, A-6	0	95-100	90-100	50-80	20-45	<30	NP-15
	8-19	Sandy loam, loam, coarse sandy loam.	SM, SC, SM-SC	A-2, A-4, A-6	0	95-100	90-100	50-80	20-45	<30	NP-15
	19-60	Gravelly coarse sand, coarse sand, very gravelly coarse sand.	SP-SM, GP, SP, GP-GM	A-1, A-2, A-3	0	35-100	25-100	10-60	0-10	---	NP
344---------- Quam	0-10	Silty clay loam	CL, ML, OL	A-7	0	100	100	90-100	85-95	40-50	15-25
	10-57	Silty clay loam, silt loam, loam.	CL, ML	A-7, A-6, A-4	0	100	100	80-100	70-95	30-50	5-25
	57-60	Clay loam, silty clay loam, silt loam.	CL, ML, CL-ML	A-4, A-6, A-7	0	100	90-100	85-95	70-90	20-50	5-20
345---------- Wilmonton	0-15	Clay loam--------	CL	A-6, A-7	0	100	90-100	85-100	60-90	30-50	12-25
	15-24	Clay loam, loam	CL	A-6, A-7	0-5	95-100	85-100	80-90	60-80	30-50	15-25
	24-60	Clay loam, loam	CL	A-6	0-5	95-100	85-100	75-85	55-75	25-40	10-25
359---------- Lamoure	0-11	Silty clay loam	CL, CH, MH, ML	A-7	0	100	100	95-100	85-100	45-70	20-35
	11-38	Silty clay loam	CL, CH, MH, ML	A-7	0	100	100	90-100	85-100	40-70	15-35
	38-60	Stratified sandy loam to silty clay loam.	CL, SC	A-6, A-7	0	95-100	95-100	70-95	35-90	30-50	10-25
392---------- Biscay	0-22	Loam----------	CL, ML	A-7, A-6	0	95-100	95-100	70-95	50-80	35-50	10-25
	22-30	Loam, clay loam, sandy clay loam.	CL, ML	A-6, A-7	0	95-100	90-100	70-90	50-75	30-50	10-20
	30-38	Gravelly loam, sandy loam, gravelly sandy loam.	SM, SM-SC, SC	A-4	0-5	95-100	70-95	50-80	35-50	15-30	2-10
	38-60	Stratified loamy sand to gravelly coarse sand.	SP, SP-SM, GP, GP-GM	A-1	0-5	45-95	35-95	20-45	2-10	---	NP
402E---------- Sioux	0-7	Sandy loam-------	SM	A-4	0-5	95-100	85-100	60-85	35-45	20-30	NP-7
	7-13	Gravelly loam, gravelly sandy loam, gravelly loamy sand.	SM, GM	A-4, A-2, A-1	0-5	60-90	50-80	45-70	15-50	20-35	NP-7
	13-60	Extremely gravelly sand, very gravelly loamy sand, very gravelly sand.	GM, GP, SM, SP	A-1	0	25-75	20-60	5-35	0-25	<25	NP-5
418---------- Lamoure	0-11	Silty clay loam	CL, CH, MH, ML	A-7	0	100	100	95-100	85-100	45-70	20-35
	11-38	Silty clay loam, silt loam.	CL, CH, MH, ML	A-7	0	100	100	90-100	85-100	40-70	15-35
	38-60	Stratified sandy loam to silty clay loam.	CL, SC	A-6, A-7	0	95-100	95-100	70-95	35-90	30-50	10-25

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
436---------- Hidewood	0-16	Silty clay loam	CL, ML	A-7, A-6	0	100	95-100	90-100	85-95	30-50	11-20
	16-31	Silty clay loam, silt loam.	CL, ML	A-7, A-6	0	100	95-100	90-100	85-95	30-50	10-20
	31-60	Clay loam, loam, silty clay loam.	CL, ML	A-6, A-7	5-20	95-100	90-100	80-100	70-80	30-50	11-20
437F---------- Buse	0-7	Loam----------	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	55-80	20-40	3-15
	7-60	Loam----------	CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	60-80	25-40	5-15
470---------- Lismore	0-8	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	90-100	35-50	15-25
	8-15	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	95-100	85-100	30-50	10-25
	15-31	Loam, clay loam	CL	A-6, A-7	0	100	95-100	85-100	70-85	30-50	10-25
	31-60	Loam, clay loam	CL	A-6, A-7	0	100	95-100	85-100	70-85	30-50	10-25
506---------- Overly	0-14	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	80-100	30-45	10-25
	14-37	Silty clay loam, silt loam, clay loam.	CL, CL-ML	A-6, A-7, A-4	0	100	100	90-100	80-100	25-50	5-30
	37-60	Stratified silt loam to silty clay.	CL, CL-ML	A-6, A-7, A-4	0	100	100	90-100	80-100	25-50	5-30
562---------- Knoke	0-10	Silty clay loam	MH, CH	A-7	0	100	100	90-100	80-95	55-70	25-40
	10-20	Silty clay loam, mucky silty clay loam.	MH, OH	A-7	0	100	100	90-100	80-95	55-90	15-40
	20-60	Silty clay loam, silty clay, clay loam.	MH, CH	A-7	0	95-100	95-100	90-100	80-95	55-70	25-40
590---------- Moines	0-14	Clay loam--------	CL	A-6	0	95-100	90-100	85-95	60-70	30-40	10-15
	14-40	Loam, clay loam	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	75-85	55-70	20-35	3-15
	40-60	Loam, clay loam	ML, CL, CL-ML	A-4, A-6	0	80-100	75-95	65-85	50-60	20-35	3-15
594---------- Jeffers	0-18	Clay loam--------	CL	A-6, A-7	0	95-100	80-100	70-85	60-80	30-45	12-20
	18-35	Clay loam, loam	CL	A-6	0	95-100	80-100	65-85	60-80	25-40	10-18
	35-60	Loam, clay loam	CL	A-6	0-2	90-100	80-95	65-85	60-80	25-40	10-18
894D2*:											
Storden---------	0-8	Loam----------	ML, CL	A-4, A-6	0-5	95-100	95-100	70-85	55-70	30-40	5-15
	8-60	Loam, clay loam	CL-ML, CL, ML	A-4, A-6	0-5	95-100	85-97	70-85	55-70	20-40	5-15
Everly----------	0-8	Clay loam--------	CL	A-6, A-7	0	100	95-100	85-95	65-80	30-45	10-20
	8-26	Clay loam, loam	CL	A-6, A-7	0	95-100	95-100	85-95	70-90	35-50	15-25
	26-60	Loam, clay loam	CL	A-6	0-5	90-100	85-95	75-85	60-80	30-40	10-20
902C2*:											
Barnes----------	0-8	Loam----------	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	80-100	50-90	20-40	5-20
	8-17	Loam, sandy clay loam.	CL, CL-ML, SC, SM-SC	A-4, A-6	0-5	90-100	85-100	75-95	35-80	25-40	5-20
	17-60	Loam----------	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
Buse----------	0-7	Loam----------	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	55-80	20-40	3-15
	7-60	Loam----------	CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	60-80	25-40	5-15

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
904B*, 904C*:											
Arvilla	0-8	Sandy loam	SM, SC, SM-SC	A-2, A-4, A-6	0	95-100	90-100	50-80	20-45	<30	NP-15
	8-19	Sandy loam, loam, coarse sandy loam.	SM, SC, SM-SC	A-2, A-4, A-6	0	95-100	90-100	50-80	20-45	<30	NP-15
	19-60	Gravelly coarse sand, coarse sand, very gravelly coarse sand.	SP-SM, GP, SP, GP-GM	A-1, A-2, A-3	0	35-100	25-100	10-60	0-10	---	NP
Barnes	0-8	Loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	80-100	50-90	20-40	5-20
	8-18	Loam, sandy clay loam.	CL, CL-ML, SC, SM-SC	A-4, A-6	0-5	90-100	85-100	75-95	35-80	25-40	5-20
	18-60	Loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
Buse	0-7	Loam	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	55-80	20-40	3-15
	7-60	Loam	CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	60-80	25-40	5-15
913D*:											
Buse	0-9	Loam	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	55-80	20-40	3-15
	9-60	Loam	CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	60-80	25-40	5-15
Barnes	0-11	Loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	80-100	50-90	20-40	5-20
	11-19	Loam, sandy clay loam.	CL, CL-ML, SC, SM-SC	A-4, A-6	0-5	90-100	85-100	75-95	35-80	25-40	5-20
	19-60	Loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-95	55-80	25-40	5-20
917D*:											
Buse	0-9	Loam	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	55-80	20-40	3-15
	9-60	Loam	CL, CL-ML	A-4, A-6	0	90-100	85-95	70-90	60-80	25-40	5-15
Sioux	0-7	Sandy loam	SM	A-4	0-5	95-100	85-100	60-85	35-45	20-30	NP-7
	7-13	Gravelly loam, gravelly sandy loam, gravelly loamy sand.	SM, GM	A-4, A-2, A-1	0-5	60-90	50-80	45-70	15-50	20-35	NP-7
	13-60	Extremely gravelly sand, very gravelly loamy sand, very gravelly sand.	GM, GP, SM, SP	A-1	0	25-75	20-60	5-35	0-25	<25	NP-5
918D*:											
Buse	0-9	Loam	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	70-95	55-90	20-35	3-15
	9-60	Loam, clay loam	CL, CL-ML, ML	A-4, A-6, A-7	0	90-100	85-100	70-90	55-85	25-45	5-20
Vienna	0-9	Silty clay loam	ML, CL	A-6, A-7	0	100	100	95-100	85-100	35-50	10-25
	9-18	Silty clay loam, silt loam.	ML, CL	A-6, A-7	0	100	95-100	90-100	85-100	35-50	10-25
	18-26	Clay loam, loam	CL	A-6, A-7	0-5	95-100	90-100	85-100	60-85	30-45	10-20
	26-60	Clay loam, loam	CL	A-6	0-5	90-100	85-100	80-100	55-80	30-40	10-20

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
920C2*:											
Storden	0-7	Loam	ML, CL	A-4, A-6	0-5	95-100	95-100	70-85	55-70	30-40	5-15
	7-60	Loam, clay loam	CL-ML, CL, ML	A-4, A-6	0-5	95-100	85-97	70-85	55-70	20-40	5-15
Clarion	0-8	Loam	CL, CL-ML	A-4, A-6	0-5	95-100	95-100	75-90	50-75	25-40	5-15
	8-19	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-90	50-75	25-40	5-15
	19-60	Loam, sandy loam	CL, CL-ML, SC, SM-SC	A-4, A-6	0-5	90-100	85-100	75-90	45-70	25-40	5-15
Arvilla	0-8	Sandy loam	SM, SC, SM-SC	A-2, A-4, A-6	0	95-100	90-100	50-80	20-45	<30	NP-15
	8-19	Sandy loam, loam, coarse sandy loam.	SM, SC, SM-SC	A-2, A-4, A-6	0	95-100	90-100	50-80	20-45	<30	NP-15
	19-60	Gravelly coarse sand, coarse sand, very gravelly coarse sand.	SP-SM, GP, SP, GP-GM	A-1, A-2, A-3	0	35-100	25-100	10-60	0-10	---	NP
921C2*:											
Clarion	0-8	Loam	CL, CL-ML	A-4, A-6	0-5	95-100	95-100	75-90	50-75	25-40	5-15
	8-19	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-90	50-75	25-40	5-15
	19-60	Loam, sandy loam	CL, CL-ML, SC, SM-SC	A-4, A-6	0-5	90-100	85-100	75-90	45-70	25-40	5-15
Storden	0-7	Loam	ML, CL	A-4, A-6	0-5	95-100	95-100	70-85	55-70	30-40	5-15
	7-60	Loam, clay loam	CL-ML, CL, ML	A-4, A-6	0-5	95-100	85-97	70-85	55-70	20-40	5-15
960D2*:											
Storden	0-8	Loam	ML, CL	A-4, A-6	0-5	95-100	95-100	70-85	55-70	30-40	5-15
	8-60	Loam, clay loam	CL-ML, CL, ML	A-4, A-6	0-5	95-100	85-97	70-85	55-70	20-40	5-15
Clarion	0-8	Loam	CL, CL-ML	A-4, A-6	0-5	95-100	95-100	75-90	50-75	25-40	5-15
	8-19	Loam, clay loam	CL, CL-ML	A-4, A-6	0-5	90-100	85-100	75-90	50-75	25-40	5-15
	19-60	Loam, sandy loam	CL, CL-ML, SC, SM-SC	A-4, A-6	0-5	90-100	85-100	75-90	45-70	25-40	5-15
964C2*:											
Vienna	0-6	Silty clay loam	ML, CL	A-6, A-7	0	100	100	95-100	85-100	35-50	10-25
	6-15	Silty clay loam, silt loam.	ML, CL	A-6, A-7	0	100	95-100	90-100	85-100	35-50	10-25
	15-25	Clay loam, loam	CL	A-6, A-7	0-5	95-100	90-100	85-100	60-85	30-45	10-20
	25-60	Clay loam, loam	CL	A-6	0-5	90-100	85-100	80-100	55-80	30-40	10-20
Buse	0-7	Loam	ML, CL, CL-ML	A-4, A-6	0	90-100	85-95	70-95	55-90	20-35	3-15
	7-60	Loam, clay loam	CL, CL-ML, ML	A-4, A-6, A-7	0	90-100	85-100	70-90	55-85	25-45	5-20
1030*:											
Pits.											
Udorthents.											

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag-ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas-ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
1051---------- Glencoe	0-33	Silty clay loam	OL, OH, MH, CL	A-6, A-7	0	95-100	90-100	75-100	60-90	30-55	10-25
	33-46	Loam, clay loam, silty clay loam.	CL	A-6, A-7	0	95-100	90-100	75-100	60-90	30-50	10-25
	46-60	Loam, clay loam	CL, ML	A-6, A-7	0	90-100	85-100	60-95	55-75	30-50	10-20
1824---------- Quam	0-10	Silty clay loam	CL, ML, OL	A-7	0	100	100	90-100	85-95	40-50	15-25
	10-25	Silty clay loam, silt loam, loam.	CL, ML	A-7, A-6, A-4	0	100	100	80-100	70-95	30-50	5-25
	25-60	Clay loam, silty clay loam, silt loam.	CL, ML, CL-ML	A-4, A-6, A-7	0	100	90-100	85-95	70-90	20-50	5-20

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
31F----------	0-9	18-27	1.35-1.45	0.6-2.0	0.20-0.22	7.4-8.4	Low----------	0.28	5	4L	1-2
Storden	9-60	18-30	1.35-1.65	0.6-2.0	0.17-0.19	7.4-8.4	Low----------	0.37			
33B, 33B2--------	0-9	18-27	1.40-1.50	0.6-2.0	0.18-0.24	6.1-7.8	Low----------	0.28	5	6	2-5
Barnes	9-17	18-30	1.50-1.60	0.6-2.0	0.15-0.19	6.1-7.8	Low----------	0.28			
	17-60	18-27	1.50-1.60	0.6-2.0	0.14-0.19	7.4-8.4	Low----------	0.37			
36----------	0-23	27-35	1.30-1.45	0.2-0.6	0.18-0.24	6.1-7.8	Moderate-----	0.28	5	6	5-8
Flom	23-33	24-35	1.45-1.60	0.2-0.6	0.15-0.19	6.6-8.4	Moderate-----	0.28			
	33-60	24-35	1.55-1.65	0.2-0.6	0.14-0.19	7.4-8.4	Moderate-----	0.28			
51----------	0-13	18-27	1.10-1.40	0.6-2.0	0.17-0.22	6.6-8.4	Low----------	0.28	5	6	2-6
La Prairie	13-36	18-35	1.10-1.50	0.6-2.0	0.17-0.22	6.6-8.4	Moderate-----	0.28			
	36-60	18-30	1.30-1.70	0.6-2.0	0.15-0.22	6.6-8.4	Moderate-----	0.28			
70----------	0-8	18-26	1.10-1.30	0.6-2.0	0.20-0.24	6.1-7.8	Low----------	0.28	5	6	5-8
Svea	8-26	18-28	1.20-1.50	0.6-2.0	0.17-0.22	6.6-7.8	Moderate-----	0.28			
	26-60	18-28	1.20-1.50	0.2-2.0	0.14-0.19	7.4-8.4	Moderate-----	0.37			
86----------	0-17	27-35	1.25-1.35	0.6-2.0	0.18-0.22	7.4-8.4	Moderate-----	0.24	5	4L	4-8
Canisteo	17-23	20-35	1.35-1.50	0.6-2.0	0.15-0.19	7.4-8.4	Moderate-----	0.32			
	23-36	10-35	1.30-1.50	0.6-2.0	0.12-0.18	7.4-8.4	Low----------	0.32			
	36-60	22-32	1.45-1.60	0.6-2.0	0.14-0.16	7.4-8.4	Low----------	0.32			
94B----------	0-35	18-26	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Low----------	0.24	5	6	4-5
Terril	35-60	15-30	1.45-1.70	0.6-2.0	0.16-0.18	6.1-7.8	Low----------	0.32			
96A, 96B---------	0-18	40-45	1.20-1.30	0.2-0.6	0.14-0.17	5.6-7.3	Moderate-----	0.32	5	4	5-7
Collinwood	18-34	35-60	1.25-1.35	0.06-0.6	0.13-0.16	5.6-7.3	High---------	0.32			
	34-60	35-45	1.25-1.40	0.06-0.6	0.11-0.15	7.4-8.4	High---------	0.32			
102B, 102B2------	0-12	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.28	5	6	3-5
Clarion	12-23	24-30	1.50-1.70	0.6-2.0	0.17-0.19	5.6-7.8	Low----------	0.37			
	23-60	12-22	1.50-1.70	0.6-2.0	0.17-0.19	7.4-8.4	Low----------	0.37			
113----------	0-20	27-35	1.35-1.40	0.6-2.0	0.19-0.21	6.6-7.3	Moderate-----	0.24	5	6	6-7
Webster	20-30	25-35	1.40-1.50	0.6-2.0	0.16-0.18	6.6-7.8	Moderate-----	0.32			
	30-60	18-29	1.50-1.70	0.6-2.0	0.17-0.19	7.4-8.4	Moderate-----	0.32			
114----------	0-33	27-35	1.35-1.45	0.2-2.0	0.18-0.22	6.1-7.8	Moderate-----	0.28	5	7	5-10
Glencoe	33-46	25-35	1.35-1.50	0.2-2.0	0.15-0.19	6.6-7.8	Moderate-----	0.28			
	46-60	22-32	1.35-1.50	0.6-2.0	0.15-0.19	6.6-7.8	Low----------	0.28			
118----------	0-17	22-27	1.35-1.40	0.6-2.0	0.20-0.22	6.6-8.4	Low----------	0.28	5	4L	5-6
Crippin	17-35	24-30	1.40-1.55	0.6-2.0	0.17-0.19	7.4-8.4	Low----------	0.28			
	35-60	22-28	1.55-1.75	0.6-2.0	0.17-0.19	7.9-8.4	Low----------	0.37			
127A, 127B, 127C-	0-15	10-18	1.35-1.50	2.0-6.0	0.13-0.15	6.1-7.3	Low----------	0.20	4	3	2-4
Sverdrup	15-28	6-18	1.40-1.55	2.0-6.0	0.08-0.14	6.1-7.8	Low----------	0.20			
	28-60	0-10	1.50-1.65	6.0-20	0.02-0.06	7.4-8.4	Low----------	0.15			
130----------	0-16	24-27	1.15-1.25	0.6-2.0	0.17-0.22	5.6-7.3	Moderate-----	0.24	5	6	4-8
Nicollet	16-28	24-35	1.25-1.35	0.6-2.0	0.15-0.19	5.6-7.8	Moderate-----	0.32			
	28-60	22-32	1.35-1.55	0.6-2.0	0.14-0.19	7.4-8.4	Low----------	0.32			
140----------	0-14	29-35	1.20-1.30	0.6-2.0	0.18-0.24	7.4-8.4	Moderate-----	0.28	5	4L	4-8
Spicer	14-31	18-35	1.25-1.35	0.6-2.0	0.16-0.22	7.4-8.4	Moderate-----	0.37			
	31-60	18-35	1.25-1.35	0.6-2.0	0.16-0.22	7.4-8.4	Low----------	0.37			

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
141A, 141B------- Egeland	0-9 9-26 26-60	10-18 10-18 5-10	1.25-1.35 1.30-1.45 1.40-1.65	2.0-6.0 2.0-6.0 2.0-6.0	0.11-0.17 0.09-0.15 0.08-0.10	5.6-7.3 6.1-7.8 6.6-8.4	Low---------- Low---------- Low----------	0.20 0.20 0.20	5	3	1-3
149B, 149B2, 149C2---------- Everly	0-13 13-21 21-60	27-30 25-35 25-35	1.40-1.45 1.45-1.55 1.60-1.70	0.6-2.0 0.6-2.0 0.2-0.6	0.17-0.19 0.15-0.17 0.17-0.19	5.6-7.3 6.1-7.3 7.4-8.4	Moderate----- Moderate----- Moderate-----	0.24 0.32 0.32	5	6	3-4
184-------------- Hamerly	0-8 8-20 20-60	18-27 18-30 18-30	1.20-1.60 1.20-1.60 1.30-1.60	0.6-2.0 0.6-2.0 0.6-2.0	0.17-0.22 0.15-0.19 0.14-0.19	6.6-8.4 7.4-8.4 7.4-8.4	Low---------- Low---------- Low----------	0.28 0.28 0.37	5	4L	4-7
210-------------- Fulda	0-16 16-41 41-60	40-50 35-60 30-50	1.20-1.30 1.20-1.35 1.20-1.40	0.06-0.2 0.06-0.6 0.2-0.6	0.14-0.20 0.13-0.16 0.16-0.19	6.6-7.8 7.4-8.4 7.9-8.4	High--------- High--------- High---------	0.28 0.28 0.28	5	4	5-10
211-------------- Lura	0-41 41-60	45-60 28-60	1.25-1.35 1.30-1.45	0.06-0.2 0.06-0.6	0.14-0.17 0.11-0.19	6.1-7.3 6.6-7.8	High--------- High---------	0.28 0.28	5	4	4-8
212-------------- Sinai	0-17 17-30 30-60	40-60 35-60 30-50	1.15-1.30 1.20-1.40 1.35-1.40	0.06-0.2 0.06-0.2 0.06-0.2	0.13-0.16 0.11-0.17 0.11-0.17	6.1-7.3 6.6-8.4 7.4-8.4	High--------- High--------- High---------	0.28 0.28 0.43	5	4	3-7
219-------------- Rolfe	0-20 20-36 36-60	22-27 38-45 24-35	1.35-1.40 1.40-1.50 1.50-1.60	0.6-2.0 0.06-0.2 0.2-2.0	0.22-0.24 0.11-0.13 0.14-0.16	5.1-7.3 6.1-7.3 6.1-8.4	Low---------- High--------- Moderate-----	0.28 0.28 0.28	3	6	3-5
229-------------- Waldorf	0-21 21-42 42-60	40-45 40-55 24-45	1.20-1.30 1.25-1.35 1.25-1.35	0.2-0.6 0.2-0.6 0.2-2.0	0.18-0.25 0.13-0.16 0.20-0.22	6.1-7.3 6.6-7.8 7.4-8.4	Moderate----- Moderate----- Moderate-----	0.28 0.28 0.28	5	4	6-8
236-------------- Vallers	0-15 15-23 23-60	28-35 18-35 18-35	1.20-1.35 1.40-1.55 1.50-1.70	0.2-0.6 0.2-0.6 0.2-0.6	0.18-0.22 0.15-0.19 0.17-0.19	7.4-8.4 7.4-8.4 7.4-8.4	Moderate----- Moderate----- Low----------	0.28 0.28 0.28	5	4L	5-8
241-------------- Letri	0-20 20-34 34-60	27-35 27-35 22-32	1.20-1.30 1.25-1.35 1.40-1.70	0.6-2.0 0.6-2.0 0.2-0.6	0.18-0.22 0.15-0.19 0.17-0.19	6.1-7.8 6.1-7.8 6.6-8.4	Moderate----- Moderate----- Moderate-----	0.28 0.28 0.28	5	6	4-8
246-------------- Marysland	0-17 17-27 27-60	18-27 18-30 1-5	1.20-1.30 1.35-1.50 1.55-1.65	0.6-2.0 0.6-2.0 >6.0	0.17-0.22 0.15-0.19 0.02-0.07	7.9-8.4 7.9-8.4 7.9-8.4	Moderate----- Moderate----- Low----------	0.28 0.28 0.15	4	4L	5-8
276-------------- Oldham	0-40 40-60	35-40 20-40	1.15-1.30 1.30-1.50	0.2-0.6 0.06-0.6	0.13-0.19 0.14-0.20	6.6-7.8 7.4-8.4	High--------- Moderate-----	0.28 0.43	5	4	4-7
284B, 284B2------ Poinsett	0-9 9-29 29-60	27-30 20-32 20-32	1.15-1.25 1.20-1.35 1.20-1.35	0.6-2.0 0.6-2.0 0.6-2.0	0.19-0.22 0.18-0.21 0.18-0.21	6.1-7.3 6.1-8.4 7.4-8.4	Moderate----- Moderate----- Moderate-----	0.32 0.43 0.43	5	7	4-6
297B, 297B2------ Vienna	0-10 10-15 15-26 26-60	27-32 24-32 25-32 20-32	1.15-1.25 1.20-1.35 1.35-1.55 1.50-1.70	0.6-2.0 0.6-2.0 0.2-0.6 0.2-0.6	0.19-0.22 0.17-0.20 0.16-0.20 0.16-0.20	6.1-7.3 6.1-7.3 6.6-8.4 7.4-8.4	Moderate----- Moderate----- Moderate----- Moderate-----	0.32 0.43 0.43 0.43	5	7	3-8
339A, 339B------- Fordville	0-7 7-15 15-27 27-60	18-25 18-30 15-30 0-5	1.20-1.30 1.25-1.40 1.25-1.45 1.60-1.80	0.6-2.0 0.6-2.0 0.6-6.0 6.0-20	0.18-0.20 0.18-0.21 0.12-0.18 0.03-0.06	6.1-7.3 6.1-7.8 6.1-8.4 7.4-8.4	Low---------- Moderate----- Low---------- Low----------	0.24 0.24 0.24 0.10	4	6	3-7

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
341A, 341B, 341C-Arvilla	0-8	6-18	1.40-1.60	2.0-6.0	0.13-0.15	6.6-8.4	Low	0.20	3	3	1-4
	8-19	6-18	1.40-1.60	2.0-6.0	0.11-0.14	6.6-8.4	Low	0.20			
	19-60	2-10	1.40-1.60	>6.0	0.02-0.05	7.4-8.4	Low	0.10			
344-Quam	0-10	28-35	1.00-1.35	0.2-0.6	0.18-0.22	6.6-7.8	Moderate	0.28	5	7	6-15
	10-57	22-35	1.25-1.45	0.2-0.6	0.16-0.22	6.6-7.8	Moderate	0.28			
	57-60	20-35	1.40-1.65	0.2-0.6	0.14-0.19	7.4-8.4	Moderate	0.37			
345-Wilmonton	0-15	27-35	1.25-1.35	0.6-2.0	0.20-0.26	6.1-7.3	Moderate	0.28	5	6	4-8
	15-24	27-32	1.30-1.45	0.2-0.6	0.15-0.19	6.1-7.8	Moderate	0.28			
	24-60	22-32	1.45-1.70	0.2-0.6	0.14-0.19	7.4-8.4	Moderate	0.37			
359-Lamoure	0-11	27-34	1.15-1.25	0.2-2.0	0.19-0.22	7.4-8.4	Moderate	0.28	5	4L	4-8
	11-38	25-34	1.20-1.35	0.2-2.0	0.17-0.20	7.4-8.4	Moderate	0.28			
	38-60	20-34	1.25-1.40	0.2-2.0	0.09-0.18	7.4-8.4	Low	0.28			
392-Biscay	0-22	18-27	1.20-1.30	0.6-2.0	0.20-0.22	6.1-7.8	Moderate	0.28	4	6	4-8
	22-30	18-30	1.25-1.35	0.6-2.0	0.17-0.19	6.6-7.8	Moderate	0.28			
	30-38	10-28	1.35-1.55	2.0-6.0	0.11-0.17	6.6-7.8	Low	0.28			
	38-60	1-6	1.55-1.65	6.0-20	0.02-0.04	7.4-8.4	Low	0.10			
402E-Sioux	0-7	10-18	1.25-1.40	2.0-6.0	0.11-0.15	6.6-8.4	Low	0.20	2	3	1-3
	7-13	10-20	1.20-1.50	2.0-6.0	0.10-0.15	7.4-8.4	Low	0.20			
	13-60	0-10	1.60-1.70	>6.0	0.03-0.06	7.4-8.4	Low	0.10			
418-Lamoure	0-11	27-34	1.15-1.25	0.2-2.0	0.19-0.22	7.4-8.4	Moderate	0.28	5	4L	4-8
	11-38	25-34	1.20-1.35	0.2-2.0	0.17-0.20	7.4-8.4	Moderate	0.28			
	38-60	20-34	1.25-1.40	0.2-2.0	0.09-0.18	7.4-8.4	Low	0.28			
436-Hidewood	0-16	27-35	1.20-1.40	0.6-2.0	0.21-0.23	6.1-7.8	Moderate	0.28	5	7	4-8
	16-31	25-35	1.30-1.50	0.2-2.0	0.18-0.20	6.6-8.4	Moderate	0.28			
	31-60	25-35	1.50-1.70	0.2-2.0	0.14-0.16	7.4-8.4	Moderate	0.28			
437F-Buse	0-7	18-27	1.40-1.50	0.6-2.0	0.17-0.22	6.6-8.4	Low	0.28	5	4L	1-3
	7-60	18-27	1.50-1.60	0.6-2.0	0.14-0.19	7.4-8.4	Low	0.37			
470-Lismore	0-8	27-30	1.15-1.25	0.6-2.0	0.19-0.22	6.1-7.3	Moderate	0.28	5	7	4-8
	8-15	25-30	1.20-1.35	0.6-2.0	0.19-0.22	6.1-7.3	Moderate	0.28			
	15-31	25-33	1.30-1.45	0.2-0.6	0.18-0.22	6.6-7.8	Moderate	0.28			
	31-60	25-30	1.50-1.70	0.2-0.6	0.16-0.18	7.4-8.4	Moderate	0.37			
506-Overly	0-14	27-39	1.20-1.40	0.2-0.6	0.17-0.23	6.6-7.8	Moderate	0.32	5	7	4-8
	14-37	18-34	1.20-1.50	0.2-0.6	0.17-0.22	6.6-8.4	Moderate	0.32			
	37-60	18-59	1.20-1.60	0.06-0.6	0.13-0.22	7.9-8.4	Moderate	0.32			
562-Knoke	0-10	27-36	1.30-1.40	0.2-0.6	0.21-0.23	7.4-8.4	High	0.37	5	4L	7-10
	10-20	27-36	1.30-1.40	0.2-0.6	0.21-0.23	7.4-8.4	High	0.37			
	20-60	35-45	1.35-1.45	0.2-0.6	0.18-0.20	7.4-8.4	High	0.37			
590-Moines	0-14	27-35	1.35-1.40	0.6-2.0	0.19-0.22	7.4-8.4	Low	0.24	5	4L	4-8
	14-40	24-30	1.40-1.55	0.6-2.0	0.17-0.22	7.4-8.4	Low	0.24			
	40-60	16-28	1.55-1.75	0.2-0.6	0.15-0.19	7.4-8.4	Low	0.37			
594-Jeffers	0-18	28-35	1.20-1.35	0.6-2.0	0.17-0.19	7.4-8.4	Moderate	0.24	5	6	4-8
	18-35	24-35	1.35-1.45	0.6-2.0	0.15-0.19	7.4-8.4	Moderate	0.32			
	35-60	18-32	1.40-1.65	0.2-0.6	0.14-0.19	7.4-8.4	Moderate	0.32			
894D2*: Storden	0-8	18-27	1.35-1.45	0.6-2.0	0.20-0.22	7.4-8.4	Low	0.28	5	4L	0-1
	8-60	18-30	1.35-1.65	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.37			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
894D2*:											
Everly	0-8	27-30	1.40-1.45	0.6-2.0	0.17-0.19	5.6-7.3	Moderate	0.24	5	6	1-2
	8-26	25-35	1.45-1.55	0.6-2.0	0.15-0.17	6.1-7.3	Moderate	0.32			
	26-60	22-32	1.55-1.65	0.6-2.0	0.17-0.19	7.4-8.4	Moderate	0.32			
902C2*:											
Barnes	0-8	18-27	1.40-1.50	0.6-2.0	0.18-0.24	6.1-7.8	Low	0.28	5	6	1-3
	8-17	18-27	1.50-1.60	0.6-2.0	0.15-0.19	6.1-7.8	Low	0.28			
	17-60	18-27	1.50-1.60	0.6-2.0	0.14-0.19	7.4-8.4	Low	0.37			
Buse	0-7	18-27	1.40-1.50	0.6-2.0	0.17-0.22	6.6-8.4	Low	0.28	5	4L	1-2
	7-60	18-27	1.50-1.60	0.6-2.0	0.14-0.19	7.4-8.4	Low	0.37			
904B*, 904C*:											
Arvilla	0-8	6-18	1.40-1.60	2.0-6.0	0.13-0.15	6.6-8.4	Low	0.20	3	3	1-4
	8-19	6-18	1.40-1.60	2.0-6.0	0.11-0.14	6.6-8.4	Low	0.20			
	19-60	2-10	1.40-1.60	>6.0	0.02-0.05	7.4-8.4	Low	0.10			
Barnes	0-8	18-27	1.40-1.50	0.6-2.0	0.18-0.24	6.1-7.8	Low	0.28	5	6	2-5
	8-18	18-27	1.50-1.60	0.6-2.0	0.15-0.19	6.1-7.8	Low	0.28			
	18-60	18-27	1.50-1.60	0.6-2.0	0.14-0.19	7.4-8.4	Low	0.37			
Buse	0-7	18-27	1.40-1.50	0.6-2.0	0.17-0.22	6.6-8.4	Low	0.28	5	4L	1-3
	7-60	18-27	1.50-1.60	0.6-2.0	0.14-0.19	7.4-8.4	Low	0.37			
913D*:											
Buse	0-9	18-27	1.40-1.50	0.6-2.0	0.17-0.22	6.6-8.4	Low	0.28	5	4L	1-3
	9-60	18-27	1.50-1.60	0.6-2.0	0.14-0.19	7.4-8.4	Low	0.37			
Barnes	0-11	18-27	1.40-1.50	0.6-2.0	0.18-0.24	6.1-7.8	Low	0.28	5	6	2-5
	11-19	18-27	1.50-1.60	0.6-2.0	0.15-0.19	6.1-7.8	Low	0.28			
	19-60	18-27	1.50-1.60	0.6-2.0	0.14-0.19	7.4-8.4	Low	0.37			
917D*:											
Buse	0-9	18-27	1.40-1.50	0.6-2.0	0.17-0.22	6.6-8.4	Low	0.28	5	4L	1-3
	9-60	18-27	1.50-1.60	0.6-2.0	0.14-0.19	7.4-8.4	Low	0.37			
Sioux	0-7	10-18	1.25-1.40	2.0-6.0	0.11-0.15	6.6-8.4	Low	0.20	2	3	1-3
	7-13	10-20	1.20-1.50	2.0-6.0	0.10-0.15	7.4-8.4	Low	0.20			
	13-60	0-10	1.60-1.70	>6.0	0.03-0.06	7.4-8.4	Low	0.10			
918D*:											
Buse	0-9	18-27	1.40-1.50	0.2-0.6	0.17-0.22	6.6-8.4	Low	0.28	5	4L	1-3
	9-60	18-35	1.55-1.65	0.2-0.6	0.14-0.19	7.4-8.4	Moderate	0.37			
Vienna	0-9	27-32	1.15-1.25	0.6-2.0	0.19-0.22	6.1-7.3	Moderate	0.32	5	7	3-8
	9-18	24-32	1.20-1.35	0.6-2.0	0.17-0.20	6.1-7.3	Moderate	0.43			
	18-26	25-32	1.35-1.55	0.2-0.6	0.16-0.20	6.6-8.4	Moderate	0.43			
	26-60	20-32	1.50-1.70	0.2-0.6	0.16-0.20	7.4-8.4	Moderate	0.43			
920C2*:											
Storden	0-7	18-27	1.35-1.45	0.6-2.0	0.20-0.22	7.4-8.4	Low	0.28	5	4L	0-1
	7-60	18-30	1.35-1.65	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.37			
Clarion	0-8	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low	0.28	5	6	1-3
	8-19	24-30	1.50-1.70	0.6-2.0	0.17-0.19	5.6-7.8	Low	0.37			
	19-60	12-22	1.50-1.70	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.37			
Arvilla	0-8	6-18	1.40-1.60	2.0-6.0	0.13-0.15	6.6-8.4	Low	0.20	3	3	1-2
	8-19	6-18	1.40-1.60	2.0-6.0	0.11-0.14	6.6-8.4	Low	0.20			
	19-60	2-10	1.40-1.60	>6.0	0.02-0.05	7.4-8.4	Low	0.10			

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors		Wind erodibility group	Organic matter
								K	T		
	In	Pct	g/cc	In/hr	In/in	pH					Pct
921C2*:											
Clarion---------	0-8	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.28	5	6	1-3
	8-19	24-30	1.50-1.70	0.6-2.0	0.17-0.19	5.6-7.8	Low----------	0.37			
	19-60	12-22	1.50-1.70	0.6-2.0	0.17-0.19	7.4-8.4	Low----------	0.37			
Storden---------	0-7	18-27	1.35-1.45	0.6-2.0	0.20-0.22	7.4-8.4	Low----------	0.28	5	4L	0-1
	7-60	18-30	1.35-1.65	0.6-2.0	0.17-0.19	7.4-8.4	Low----------	0.37			
960D2*:											
Storden---------	0-8	18-27	1.35-1.45	0.6-2.0	0.20-0.22	7.4-8.4	Low----------	0.28	5	4L	0-1
	8-60	18-30	1.35-1.65	0.6-2.0	0.17-0.19	7.4-8.4	Low----------	0.37			
Clarion---------	0-8	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.28	5	6	1-3
	8-19	24-30	1.50-1.70	0.6-2.0	0.17-0.19	5.6-7.8	Low----------	0.37			
	19-60	12-22	1.50-1.70	0.6-2.0	0.17-0.19	7.4-8.4	Low----------	0.37			
964C2*:											
Vienna----------	0-6	27-32	1.15-1.25	0.6-2.0	0.19-0.22	6.1-7.3	Moderate-----	0.32	5	7	2-4
	6-15	24-32	1.20-1.35	0.6-2.0	0.17-0.20	6.1-7.3	Moderate-----	0.43			
	15-25	25-32	1.35-1.55	0.2-0.6	0.16-0.20	6.6-8.4	Moderate-----	0.43			
	25-60	20-32	1.50-1.70	0.2-0.6	0.16-0.20	7.4-8.4	Moderate-----	0.43			
Buse------------	0-7	18-27	1.40-1.50	0.2-0.6	0.17-0.22	6.6-8.4	Low----------	0.28	5	4L	1-2
	7-60	18-35	1.55-1.65	0.2-0.6	0.14-0.19	7.4-8.4	Moderate-----	0.37			
1030*:											
Pits.											
Udorthents.											
1051------------	0-33	27-35	1.35-1.45	0.2-2.0	0.18-0.22	6.1-7.8	Moderate-----	0.28	5	8	5-10
Glencoe	33-46	25-35	1.35-1.50	0.2-2.0	0.15-0.19	6.6-7.8	Moderate-----	0.28			
	46-60	22-32	1.35-1.50	0.6-2.0	0.15-0.19	7.4-7.8	Low----------	0.28			
1824------------	0-10	28-35	1.00-1.35	0.2-0.6	0.18-0.22	6.6-7.8	Moderate-----	0.28	5	7	6-15
Quam	10-25	22-35	1.25-1.45	0.2-0.6	0.16-0.22	6.6-7.8	Moderate-----	0.28			
	25-60	20-35	1.40-1.65	0.2-0.6	0.14-0.19	7.4-8.4	Moderate-----	0.37			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydrologic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
31F---------- Storden	B	None--------	---	---	>6.0	---	---	Moderate	Low------	Low.
33B, 33B2---------- Barnes	B	None--------	---	---	>6.0	---	---	Moderate	Moderate	Low.
36---------- Flom	B/D	None--------	---	---	1.0-3.0	Apparent	Nov-Jun	High-----	High-----	Low.
51---------- La Prairie	B	Occasional	Brief-----	Mar-Jun	3.5-6.0	Apparent	Mar-Jun	Moderate	Moderate	Low.
70---------- Svea	B	None--------	---	---	4.0-6.0	Apparent	Apr-Jun	Moderate	High-----	Low.
86---------- Canisteo	B/D	None--------	---	---	1.0-3.0	Apparent	Oct-Jul	High-----	High-----	Low.
94B---------- Terril	B	None--------	---	---	>6.0	---	---	Moderate	Moderate	Low.
96A, 96B---------- Collinwood	C	None--------	---	---	2.0-5.0	Apparent	Nov-May	High-----	High-----	Low.
102B, 102B2------- Clarion	B	None--------	---	---	>6.0	---	---	Moderate	Low------	Low.
113---------- Webster	B/D	None--------	---	---	1.0-2.0	Apparent	Nov-Jul	High-----	High-----	Low.
114---------- Glencoe	B/D	None--------	---	---	+1-1.0	Apparent	Oct-Jul	High-----	High-----	Low.
118---------- Crippin	B	None--------	---	---	2.0-4.0	Apparent	Nov-Jun	High-----	High-----	Low.
127A, 127B, 127C-- Sverdrup	B	None--------	---	---	>6.0	---	---	Low------	Low------	Low.
130---------- Nicollet	B	None--------	---	---	2.5-5.0	Apparent	Mar-Jun	High-----	High-----	Low.
140---------- Spicer	B/D	None--------	---	---	1.0-3.0	Apparent	Nov-Jun	High-----	High-----	Low.
141A, 141B-------- Egeland	B	None--------	---	---	>6.0	---	---	Low------	Moderate	Low.
149B, 149B2, 149C2---------- Everly	B	None--------	---	---	>6.0	---	---	Moderate	Moderate	Moderate.
184---------- Hamerly	C	None--------	---	---	2.5-4.0	Apparent	Apr-Jun	High-----	High-----	Low.
210---------- Fulda	C/D	Rare--------	---	---	1.0-3.0	Apparent	Mar-Jun	High-----	High-----	Low.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
211--Lura	C/D	None	---	---	+1-1.0	Apparent	Nov-May	High	High	Low.
212--Sinai	C	None	---	---	>6.0	---	---	Low	High	High.
219--Rolfe	C	None	---	---	+1-1.0	Apparent	Nov-Jul	High	High	Moderate.
229--Waldorf	C/D	None	---	---	0-3.0	Apparent	Nov-Jun	High	High	Low.
236--Vallers	C	None	---	---	1.0-2.5	Apparent	Nov-Jun	High	High	Low.
241--Letri	B/D	None	---	---	0.5-2.0	Perched	Apr-Jun	High	High	Low.
246--Marysland	B/D	Rare	---	---	1.0-2.5	Apparent	Nov-Jul	High	High	Low.
276--Oldham	C/D	None	---	---	+2-1.0	Apparent	Oct-Jun	High	Moderate	High.
284B, 284B2--Poinsett	B	None	---	---	>6.0	---	---	High	High	Low.
297B, 297B2--Vienna	B	None	---	---	>6.0	---	---	Moderate	High	Moderate.
339A, 339B--Fordville	B	None	---	---	>6.0	---	---	Low	Moderate	Low.
341A, 341B, 341C--Arvilla	B	None	---	---	>6.0	---	---	Low	Moderate	Low.
344--Quam	B/D	None	---	---	+2-1.0	Apparent	Jan-Dec	High	High	Low.
345--Wilmonton	B	None	---	---	2.5-5.0	Apparent	Mar-Jun	High	Moderate	Low.
359--Lamoure	C	Frequent	Brief	Mar-Oct	0-2.0	Apparent	Oct-Jun	High	High	Moderate.
392--Biscay	B/D	None	---	---	1.0-3.0	Apparent	Nov-Jun	High	Moderate	Low.
402E--Sioux	A	None	---	---	>6.0	---	---	Low	Low	Low.
418--Lamoure	C	Occasional	Brief	Mar-Oct	0-2.0	Apparent	Oct-Jun	High	High	Moderate.
436--Hidewood	B/D	Rare	---	---	1.0-3.0	Perched	Apr-Jun	High	High	Low.
437F--Buse	B	None	---	---	>6.0	---	---	Moderate	Low	Low.
470--Lismore	B	None	---	---	4.0-6.0	Perched	Oct-Jun	High	High	Moderate.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
506---------- Overly	C	None--------	---	---	4.0-6.0	Apparent	Apr-Jun	High-----	High-----	Low.
562---------- Knoke	B/D	None--------	---	---	+1-1.0	Apparent	Nov-Jul	High-----	High-----	Low.
590---------- Moines	C	None--------	---	---	1.5-3.0	Apparent	Mar-Jun	High-----	High-----	Low.
594---------- Jeffers	B/D	None--------	---	---	1.0-2.0	Apparent	Mar-Jun	High-----	High-----	Moderate.
894D2*:										
Storden----------	B	None--------	---	---	>6.0	---	---	Moderate	Low------	Low.
Everly----------	B	None--------	---	---	>6.0	---	---	Moderate	Moderate	Moderate.
902C2*:										
Barnes----------	B	None--------	---	---	>6.0	---	---	Moderate	Moderate	Low.
Buse----------	B	None--------	---	---	>6.0	---	---	Moderate	Low------	Low.
904B*, 904C*:										
Arvilla----------	B	None--------	---	---	>6.0	---	---	Low------	Moderate	Low.
Barnes----------	B	None--------	---	---	>6.0	---	---	Moderate	Moderate	Low.
Buse----------	B	None--------	---	---	>6.0	---	---	Moderate	Low------	Low.
913D*:										
Buse----------	B	None--------	---	---	>6.0	---	---	Moderate	Low------	Low.
Barnes----------	B	None--------	---	---	>6.0	---	---	Moderate	Moderate	Low.
917D*:										
Buse----------	B	None--------	---	---	>6.0	---	---	Moderate	Low------	Low.
Sioux----------	A	None--------	---	---	>6.0	---	---	Low------	Low------	Low.
918D*:										
Buse----------	B	None--------	---	---	>6.0	---	---	Moderate	Low------	Low.
Vienna----------	B	None--------	---	---	>6.0	---	---	Moderate	High-----	Moderate.
920C2*:										
Storden----------	B	None--------	---	---	>6.0	---	---	Moderate	Low------	Low.
Clarion----------	B	None--------	---	---	>6.0	---	---	Moderate	Low------	Low.
Arvilla----------	B	None--------	---	---	>6.0	---	---	Low------	Moderate	Low.
921C2*:										
Clarion----------	B	None--------	---	---	>6.0	---	---	Moderate	Low------	Low.
Storden----------	B	None--------	---	---	>6.0	---	---	Moderate	Low------	Low.
960D2*:										
Storden----------	B	None--------	---	---	>6.0	---	---	Moderate	Low------	Low.
Clarion----------	B	None--------	---	---	>6.0	---	---	Moderate	Low------	Low.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months		Uncoated steel	Concrete
					Ft					
964C2*:										
Vienna	B	None	---	---	>6.0	---	---	Moderate	High	Moderate.
Buse	B	None	---	---	>6.0	---	---	Moderate	Low	Low.
1030*:										
Pits.										
Udorthents.										
1051 Glencoe	D	Rare	---	---	+3-1.0	Apparent	Jan-Dec	High	High	Low.
1824 Quam	B/D	None	---	---	+2-1.0	Apparent	Jan-Dec	High	High	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Arvilla	Sandy, mixed Udic Haploborolls
Barnes	Fine-loamy, mixed Udic Haploborolls
Biscay	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Haplaquolls
Buse	Fine-loamy, mixed Udorthentic Haploborolls
Canisteo	Fine-loamy, mixed (calcareous), mesic Typic Haplaquolls
Clarion	Fine-loamy, mixed, mesic Typic Hapludolls
Collinwood	Fine, montmorillonitic, mesic Aquic Hapludolls
Crippin	Fine-loamy, mixed, mesic Aquic Hapludolls
Egeland	Coarse-loamy, mixed Udic Haploborolls
Everly	Fine-loamy, mixed, mesic Typic Hapludolls
Flom	Fine-loamy, mixed, frigid Typic Haplaquolls
Fordville	Fine-loamy over sandy or sandy-skeletal, mixed Pachic Udic Haploborolls
Fulda	Fine, montmorillonitic, frigid Typic Haplaquolls
Glencoe	Fine-loamy, mixed, mesic Cumulic Haplaquolls
Hamerly	Fine-loamy, frigid Aeric Calciaquolls
Hidewood	Fine-silty, mixed, frigid Typic Haplaquolls
Jeffers	Fine-loamy, mixed (calcareous), mesic Typic Haplaquolls
Knoke	Fine, montmorillonitic (calcareous), mesic Cumulic Haplaquolls
La Prairie	Fine-loamy, mixed Cumulic Udic Haploborolls
Lamoure	Fine-silty, mixed (calcareous), frigid Cumulic Haplaquolls
Letri	Fine-loamy, mixed, mesic Typic Haplaquolls
Lismore	Fine-loamy, mixed Pachic Udic Haploborolls
Lura	Fine, montmorillonitic, mesic Cumulic Haplaquolls
Marysland	Fine-loamy over sandy or sandy-skeletal, frigid Typic Calciaquolls
Moines	Fine-loamy, mesic Aeric Calciaquolls
Nicollet	Fine-loamy, mixed, mesic Aquic Hapludolls
Oldham	Fine, montmorillonitic (calcareous), frigid Cumulic Haplaquolls
Overly	Fine-silty, mixed Pachic Udic Haploborolls
Poinsett	Fine-silty, mixed Udic Haploborolls
Quam	Fine-silty, mixed, frigid Cumulic Haplaquolls
Rolfe	Fine, montmorillonitic, mesic Typic Argialbolls
Sinai	Fine, montmorillonitic Udertic Haploborolls
Sioux	Sandy-skeletal, mixed Udorthentic Haploborolls
Spicer	Fine-silty, mixed (calcareous), mesic Typic Haplaquolls
Storden	Fine-loamy, mixed (calcareous), mesic Typic Udorthents
Svea	Fine-loamy, mixed Pachic Udic Haploborolls
Sverdrup	Sandy, mixed Udic Haploborolls
Terril	Fine-loamy, mixed, mesic Cumulic Hapludolls
Udorthents	Loamy, mixed, mesic Typic Udorthents
Vallers	Fine-loamy, frigid Typic Calciaquolls
Vienna	Fine-loamy, mixed Udic Haploborolls
Waldorf	Fine, montmorillonitic, mesic Typic Haplaquolls
Webster	Fine-loamy, mixed, mesic Typic Haplaquolls
Wilmonton	Fine-loamy, mixed, mesic Aquic Hapludolls

This page intentionally left blank.

Interpretive Groups

INTERPRETIVE GROUPS

(Dashes indicate that the soil was not assigned to the interpretive group)

Soil name and map symbol	Land capability	Prime farmland	Windbreak suitability group
31F---------- Storden	VIIe	---	10
33B---------- Barnes	IIe	Yes	3
33B2---------- Barnes	IIe	Yes	3
36---------- Flom	IIw	Yes	2
51---------- La Prairie	IIw	Yes	1
70---------- Svea	I	Yes	1
86---------- Canisteo	IIw	Yes	2K
94B---------- Terril	IIe	Yes	3
96A---------- Collinwood	IIw	Yes	4C
96B---------- Collinwood	IIe	Yes	4C
102B---------- Clarion	IIe	Yes	3
102B2---------- Clarion	IIe	Yes	3
113---------- Webster	IIw	Yes	2
114---------- Glencoe	IIw	Yes	2W
118---------- Crippin	I	Yes	1K
127A---------- Sverdrup	IIIs	---	6G
127B---------- Sverdrup	IIIe	---	6G
127C---------- Sverdrup	IVe	---	6G
130---------- Nicollet	I	Yes	1
140---------- Spicer	IIw	Yes	2K

INTERPRETIVE GROUPS--Continued

Soil name and map symbol	Land capability	Prime farmland	Windbreak suitability group
141A---------- Egeland	IIIs	Yes	5
141B---------- Egeland	IIIe	Yes	5
149B---------- Everly	IIe	Yes	3
149B2---------- Everly	IIe	Yes	3
149C2---------- Everly	IIIe	---	3
184---------- Hamerly	IIs	Yes	1K
210---------- Fulda	IIw	Yes	2
211---------- Lura	IIIw	Yes	2W
212---------- Sinai	IIs	Yes	4C
219---------- Rolfe	IIIw	Yes	2W
229---------- Waldorf	IIw	Yes	2
236---------- Vallers	IIw	Yes	2K
241---------- Letri	IIw	Yes	2
246---------- Marysland	IIw	Yes	2K
276---------- Oldham	IIIw	Yes	2W
284B---------- Poinsett	IIe	Yes	3
284B2---------- Poinsett	IIIe	Yes	3
297B---------- Vienna	IIe	Yes	3
297B2---------- Vienna	IIe	Yes	3
339A---------- Fordville	IIs	Yes	6G
339B---------- Fordville	IIe	Yes	6G

INTERPRETIVE GROUPS--Continued

Soil name and map symbol	Land capability	Prime farmland	Windbreak suitability group
341A---------- Arvilla	IIIs	---	7
341B---------- Arvilla	IIIe	---	7
341C---------- Arvilla	IVe	---	7
344---------- Quam	IIIw	Yes	2W
345---------- Wilmonton	I	Yes	1
359---------- Lamoure	VIw	---	10
392---------- Biscay	IIw	Yes	2
402E---------- Sioux	VIs	---	10
418---------- Lamoure	IIw	Yes	2K
436---------- Hidewood	IIw	Yes	2
437F---------- Buse	VIIe	---	10
470---------- Lismore	I	Yes	1
506---------- Overly	I	Yes	1
562---------- Knoke	IIIw	Yes	2W
590---------- Moines	IIs	Yes	1K
594---------- Jeffers	IIw	Yes	2K
894D2:			
Storden----------	IVe	---	8
Everly----------	IIIe	---	3
902C2:			
Barnes----------	IIIe	---	3
Buse----------	IIIe	---	8
904B:			
Arvilla----------	IIIe	---	7
Barnes----------	IIe	---	3
Buse----------	IIe	---	8

INTERPRETIVE GROUPS--Continued

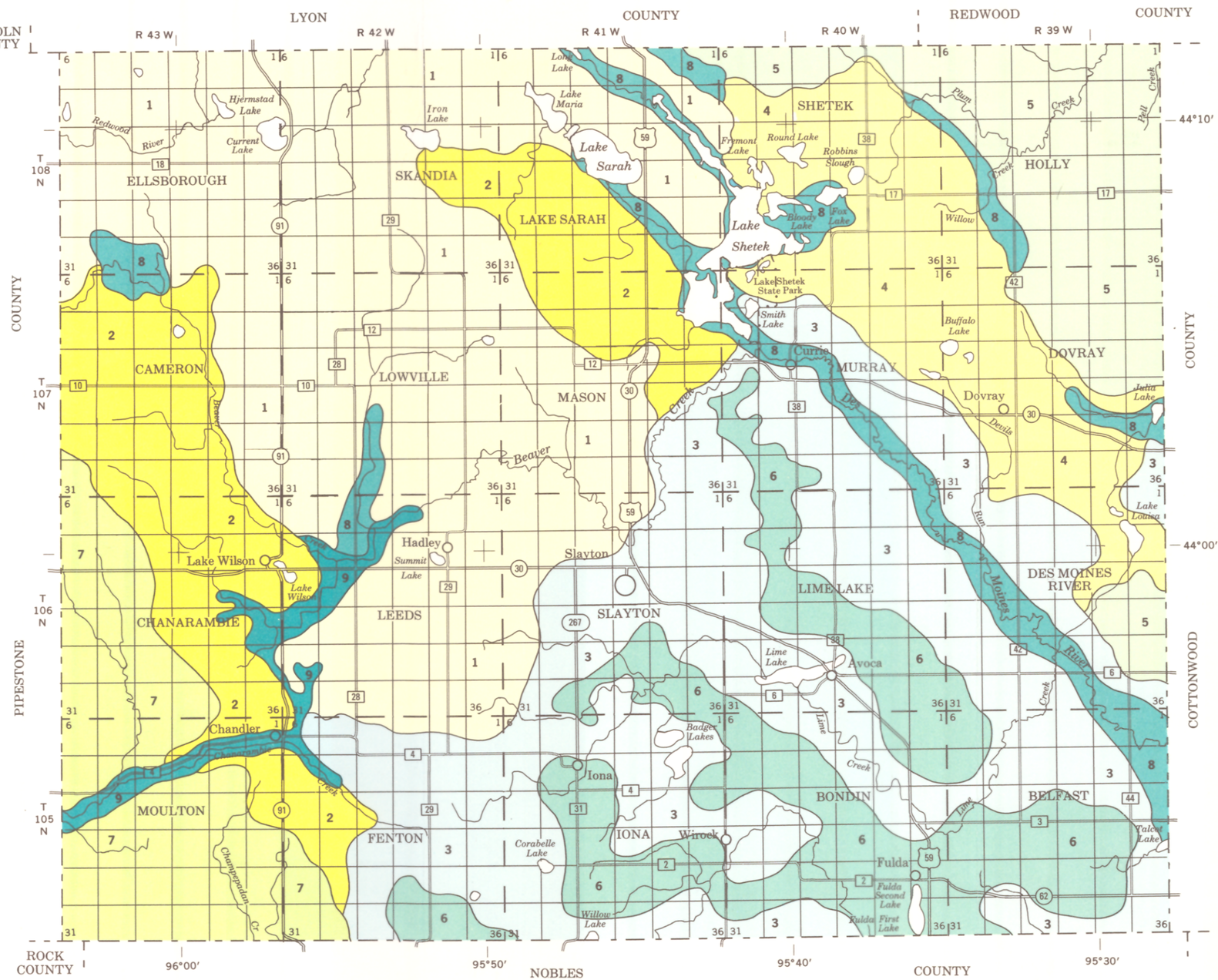
Soil name and map symbol	Land capability	Prime farmland	Windbreak suitability group
904C:			
Arvilla	IVe	---	7
Barnes	IIIe	---	3
Buse	IIIe	---	8
913D:			
Buse	IVe	---	8
Barnes	IVe	---	3
917D:			
Buse	IVe	---	8
Sioux	VIs	---	10
918D:			
Buse	IVe	---	8
Vienna	IVe	---	3
920C2:			
Storden	IVe	---	8
Clarion	IIIe	---	3
Arvilla	IIIe	---	7
921C2:			
Clarion	IIIe	---	3
Storden	IIIe	---	8
960D2:			
Storden	IVe	---	8
Clarion	IVe	---	3
964C2:			
Vienna	IVe	---	3
Buse	IIIe	---	8
1030: Pits. Udorthents.			
1051 Glencoe	VIIIw	---	10
1824 Quam	VIIIw	---	10

U.S. GOVERNMENT PRINTING OFFICE: 1990-262-945/20033

Accessibility Statement

This document is not accessible by screen-reader software. The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at 1-800-457-3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at http://offices.sc.egov.usda.gov/locator/app.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410, or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.



SOIL LEGEND

AREAS DOMINATED BY SOILS THAT FORMED IN FRIABLE GLACIAL TILL

1 — BARNES-FLOM-VALLERS association: Well drained and poorly drained, nearly level to moderately steep soils that formed in loamy glacial till

2 — BARNES-BUSE association: Well drained, gently undulating to very steep soils that formed in loamy glacial till

3 — CLARION-WEBSTER-NICOLLET association: Well drained, poorly drained, and moderately well drained, nearly level to hilly soils that formed in loamy glacial till

4 — CLARION-STORDEN association: Well drained, undulating to very steep soils that formed in loamy glacial till

AREAS DOMINATED BY SOILS THAT FORMED IN FRIABLE AND FIRM GLACIAL TILL

5 — EVERLY-LETRI-WILMONTON association: Well drained, poorly drained, and moderately well drained, nearly level to moderately steep soils that formed in loamy glacial till

AREAS DOMINATED BY SOILS THAT FORMED IN GLACIOLACUSTRINE SEDIMENTS OR GLACIAL TILL

6 — COLLINWOOD-CLARION-WALDORF association: Moderately well drained, well drained, and poorly drained, nearly level to sloping soils that formed in clayey lacustrine sediments or loamy glacial till

AREAS DOMINATED BY SOIL THAT FORMED IN LOESS AND GLACIAL TILL

7 — VIENNA-HIDEWOOD-LISMORE association: Well drained, poorly drained, and moderately well drained, nearly level to hilly soils that formed in silty loess and in glacial till

AREAS DOMINATED BY SOILS THAT FORMED IN GLACIAL OUTWASH AND ALLUVIUM

8 — ARVILLA-EGELAND-MARYSLAND association: Somewhat excessively drained, well drained, and poorly drained, nearly level to moderately steep soils that formed in loamy material over sandy and gravelly deposits

9 — LAMOURE-LA PRAIRIE association: Poorly drained and moderately well drained, nearly level soils that formed in silty and loamy alluvial material

Compiled 1989

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
MINNESOTA AGRICULTURAL EXPERIMENT STATION
AGRICULTURAL EXTENSION SERVICE
SOIL AND WATER CONSERVATION BOARD
MURRAY SOIL AND WATER CONSERVATION DISTRICT

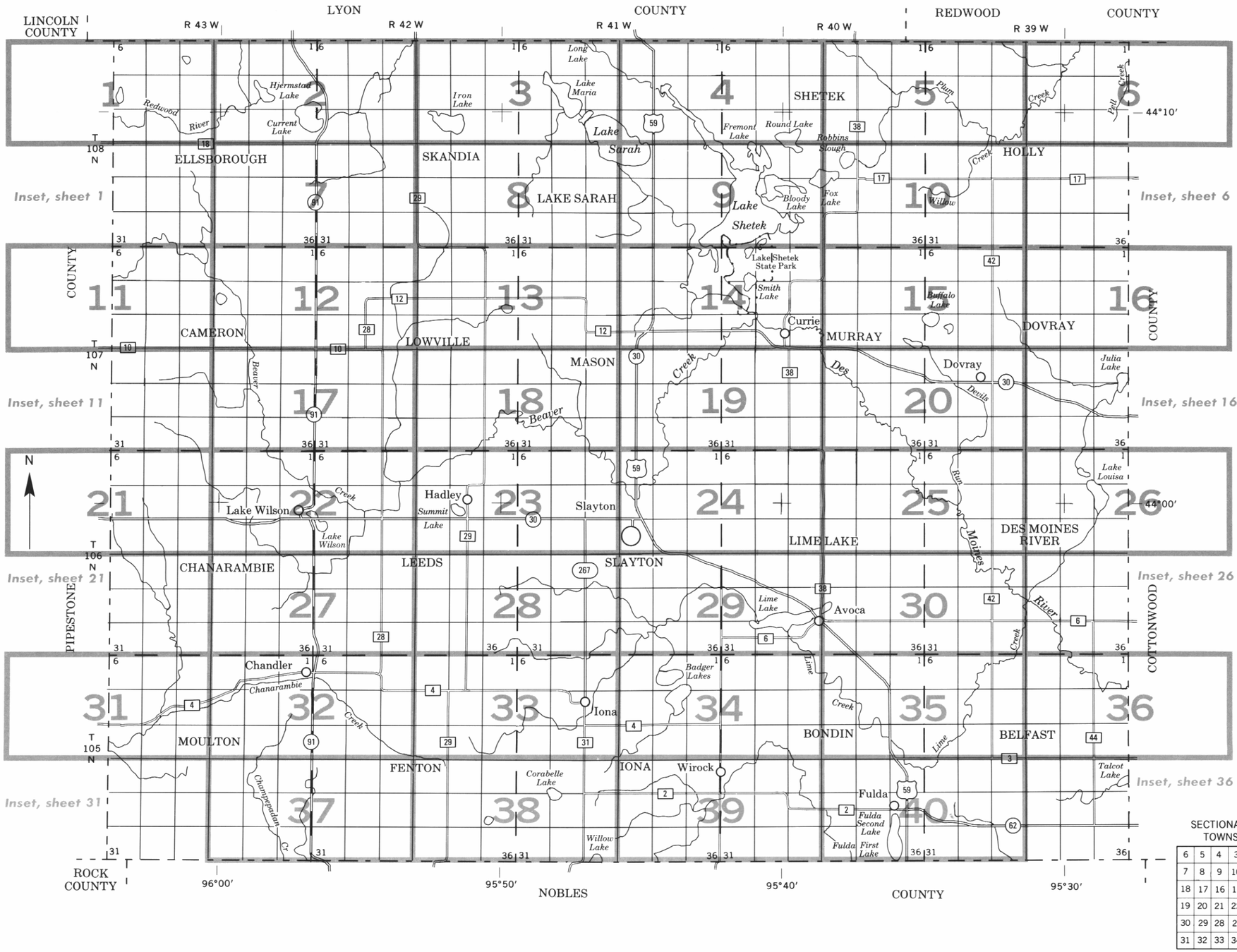
GENERAL SOIL MAP

MURRAY COUNTY, MINNESOTA

Scale 1:190,080

1 0 1 2 3 Mi

1 0 3 6



SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

INDEX TO MAP SHEETS

MURRAY COUNTY, MINNESOTA

Scale 1:190,080

1 0 1 2 3 Mi

1 0 3 6

SOIL LEGEND

Map symbols consist of numbers or a combination of numbers and a letter. The initial numbers represent the kind of soil. A capital letter following these numbers indicates the class of slope. Symbols without a slope letter are for nearly level soils or miscellaneous areas.

SYMBOL	NAME
31F	Storden loam, 18 to 40 percent slopes
33B	Barnes loam, 2 to 4 percent slopes
33B2	Barnes loam, 3 to 6 percent slopes, eroded
36	Flom clay loam
51	La Prairie loam
70	Svea loam
86	Canisteo clay loam
94B	Terril loam, 2 to 8 percent slopes
96A	Collinwood silty clay, 0 to 2 percent slopes
96B	Collinwood silty clay, 2 to 6 percent slopes
102B	Clarion loam, 2 to 4 percent slopes
102B2	Clarion loam, 3 to 6 percent slopes, eroded
113	Webster clay loam
114	Glencoe silty clay loam
118	Crippin loam
127A	Sverdrup sandy loam, 0 to 2 percent slopes
127B	Sverdrup sandy loam, 2 to 6 percent slopes
127C	Sverdrup sandy loam, 6 to 12 percent slopes
130	Nicollet loam
140	Spicer silty clay loam
141A	Egeland sandy loam, 0 to 2 percent slopes
141B	Egeland sandy loam, 2 to 6 percent slopes
149B	Everly clay loam, 2 to 4 percent slopes
149B2	Everly clay loam, 3 to 6 percent slopes, eroded
149C2	Everly clay loam, 6 to 12 percent slopes, eroded
184	Hamerly loam
210	Fulda silty clay
211	Lura silty clay
212	Sinai silty clay
219	Rolfe silt loam
229	Waldorf silty clay
236	Vallers clay loam
241	Letri clay loam
246	Marysland loam
276	Oldham silty clay loam
284B	Poinsett silty clay loam, 2 to 4 percent slopes
284B2	Poinsett silty clay loam, 3 to 6 percent slopes, eroded
297B	Vienna silty clay loam, 2 to 4 percent slopes
297B2	Vienna silty clay loam, 3 to 6 percent slopes, eroded
339A	Fordville loam, 0 to 2 percent slopes
339B	Fordville loam, 2 to 6 percent slopes
341A	Arvilla sandy loam, 0 to 2 percent slopes
341B	Arvilla sandy loam, 2 to 6 percent slopes
341C	Arvilla sandy loam, 6 to 12 percent slopes
344	Quam silty clay loam
345	Wilmonton clay loam
359	Lamoure silty clay loam, frequently flooded
392	Biscay loam
402E	Sioux sandy loam, 2 to 40 percent slopes
418	Lamoure silty clay loam, occasionally flooded
436	Hidewood silty clay loam
437F	Buse loam, 18 to 40 percent slopes
470	Lismore silty clay loam
506	Overly silty clay loam
562	Knoke silty clay loam
590	Moines clay loam
594	Jeffers clay loam
894D2	Storden-Everly complex, 12 to 18 percent slopes, eroded
902C2	Barnes-Buse loams, 6 to 12 percent slopes, eroded
904B	Arvilla-Barnes-Buse complex, 2 to 6 percent slopes
904C	Arvilla-Barnes-Buse complex, 6 to 12 percent slopes
913D	Buse-Barnes loams, 12 to 18 percent slopes
917D	Buse-Sioux complex, 12 to 18 percent slopes
918D	Buse-Vienna complex, 12 to 18 percent slopes
920C2	Storden-Clarion-Arvilla complex, 6 to 15 percent slopes, eroded
921C2	Clarion-Storden loams, 6 to 12 percent slopes, eroded
960D2	Storden-Clarion loams, 12 to 18 percent slopes, eroded
964C2	Vienna-Buse complex, 6 to 12 percent slopes, eroded
1030	Pits, gravel-Udorthents complex
1051	Glencoe silty clay loam, ponded
1824	Quam silty clay loam, ponded

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline and neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool

STATE COORDINATE TICK

LAND DIVISION CORNER (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEM & DESIGNATIONS

- Interstate
- Federal
- State
- County, farm or ranch

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or Small

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label)
- Located object (label)
- Tank (label)
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label)
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial
- Intermittent

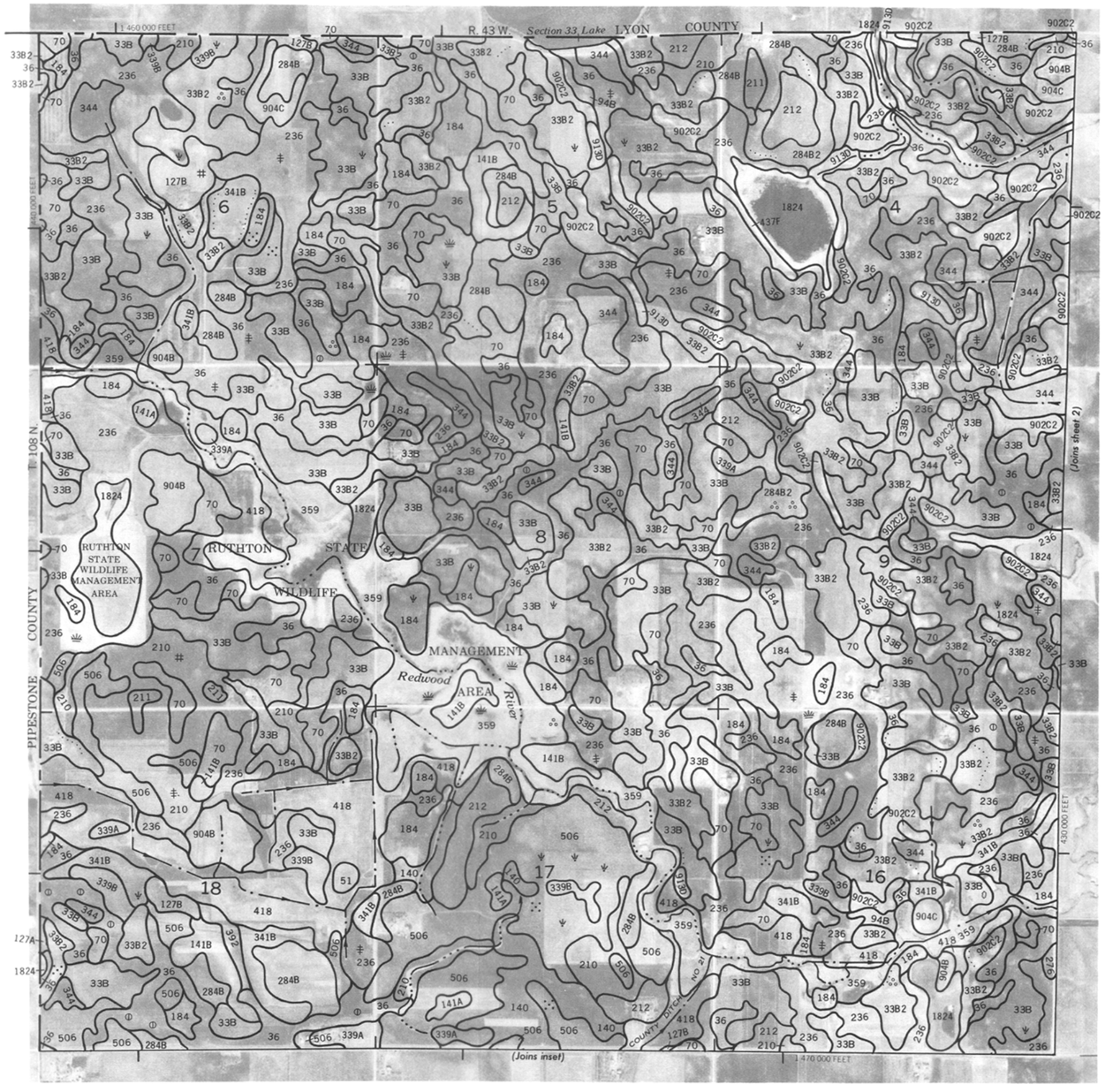
MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

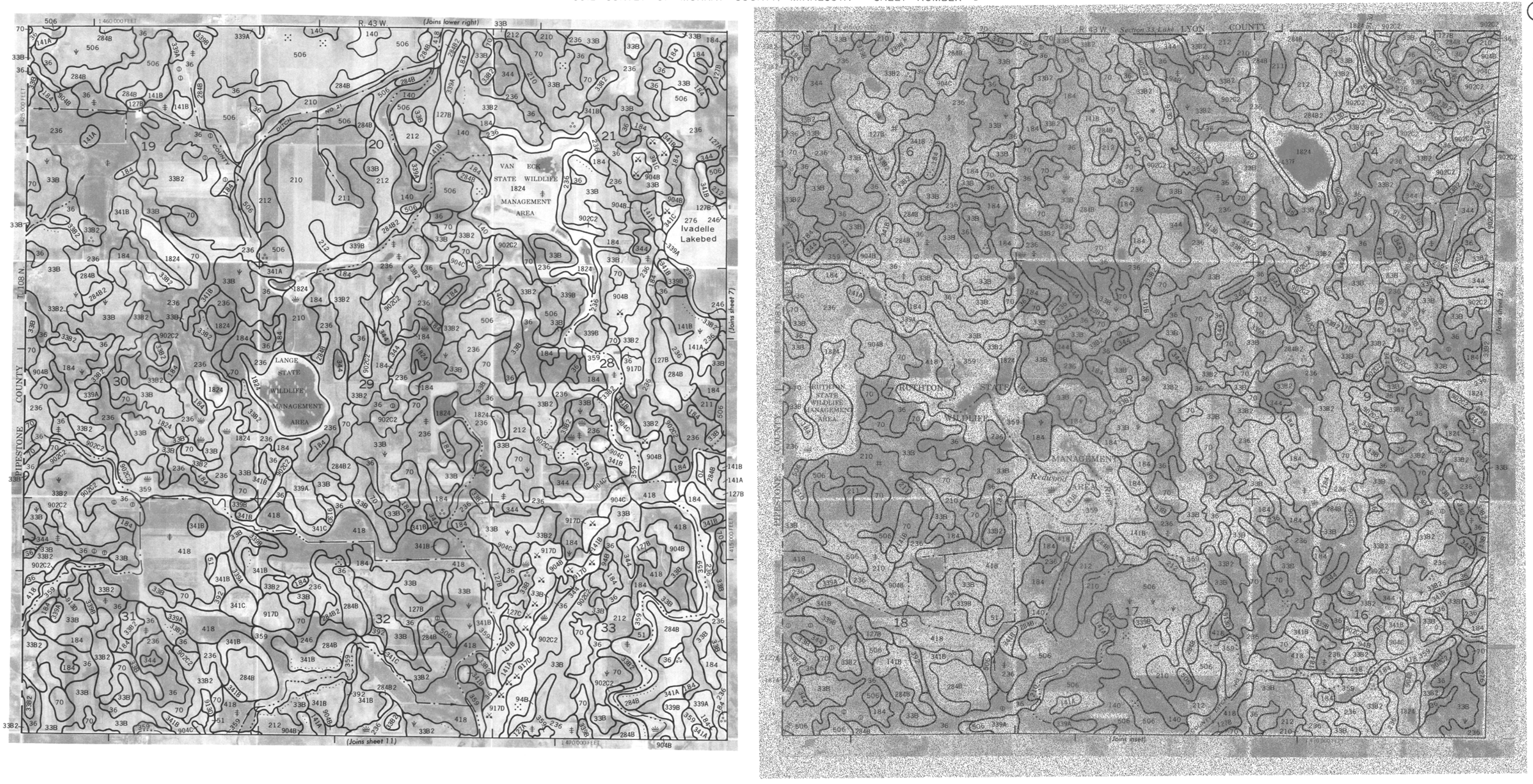
SPECIAL SYMBOLS FOR SOIL SURVEY

- SOIL DELINEATIONS AND SYMBOLS (102B / 130)
- ESCARPMENTS
  - Bedrock (points down slope)
  - Other than bedrock (points down slope)
- SHORT STEEP SLOPE
- GULLY
- DEPRESSION OR SINK
- SOIL SAMPLE (normally not shown)
- MISCELLANEOUS
  - Blowout
  - Clay spot
  - Gravelly spot
  - Gumbo, slick or scabby spot (sodic)
  - Dumps and other similar non soil areas
  - Prominent hill or peak
  - Rock outcrop (includes sandstone and shale)
  - Saline spot
  - Sandy spot
  - Severely eroded spot
  - Slide or slip (tips point upslope)
  - Stony spot, very stony spot
  - High lime areas
  - Better drained area in a poorly drained soil
  - Argialbolls Small areas with restricted drainage

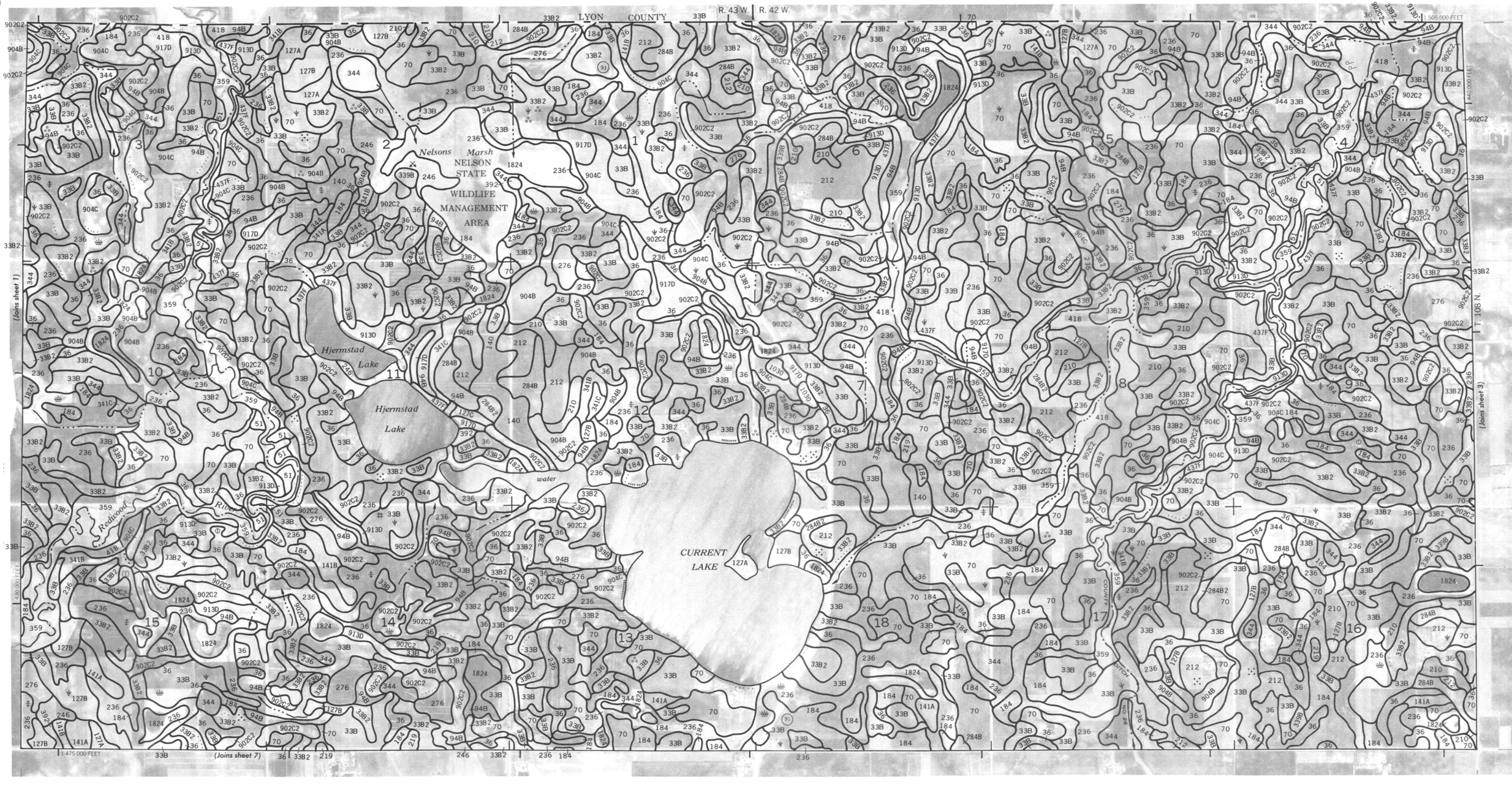
SOIL SURVEY OF MURRAY COUNTY, MINNESOTA - SHEET NUMBER 1



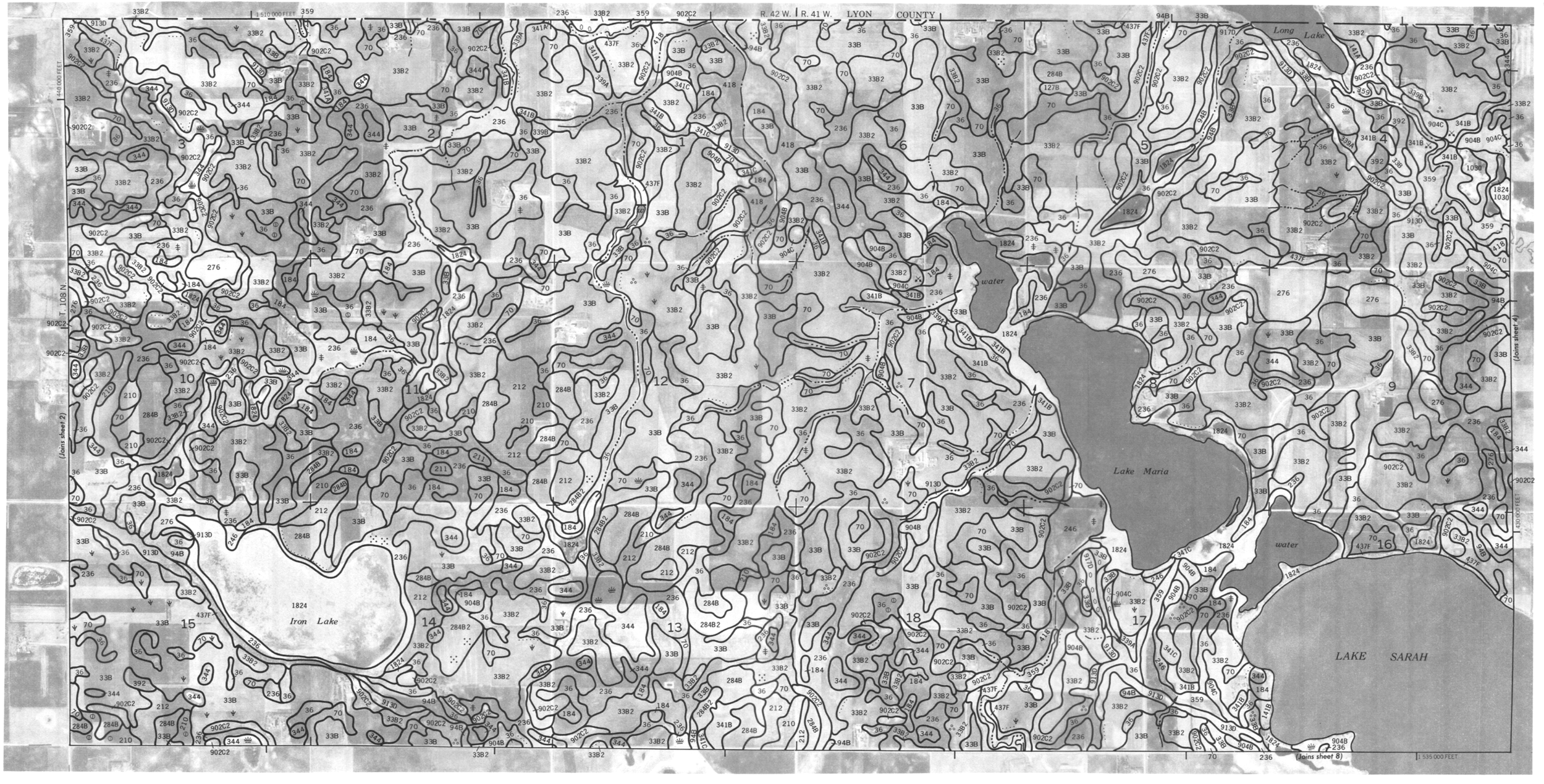
SOIL SURVEY OF MURRAY COUNTY, MINNESOTA - SHEET NUMBER 1

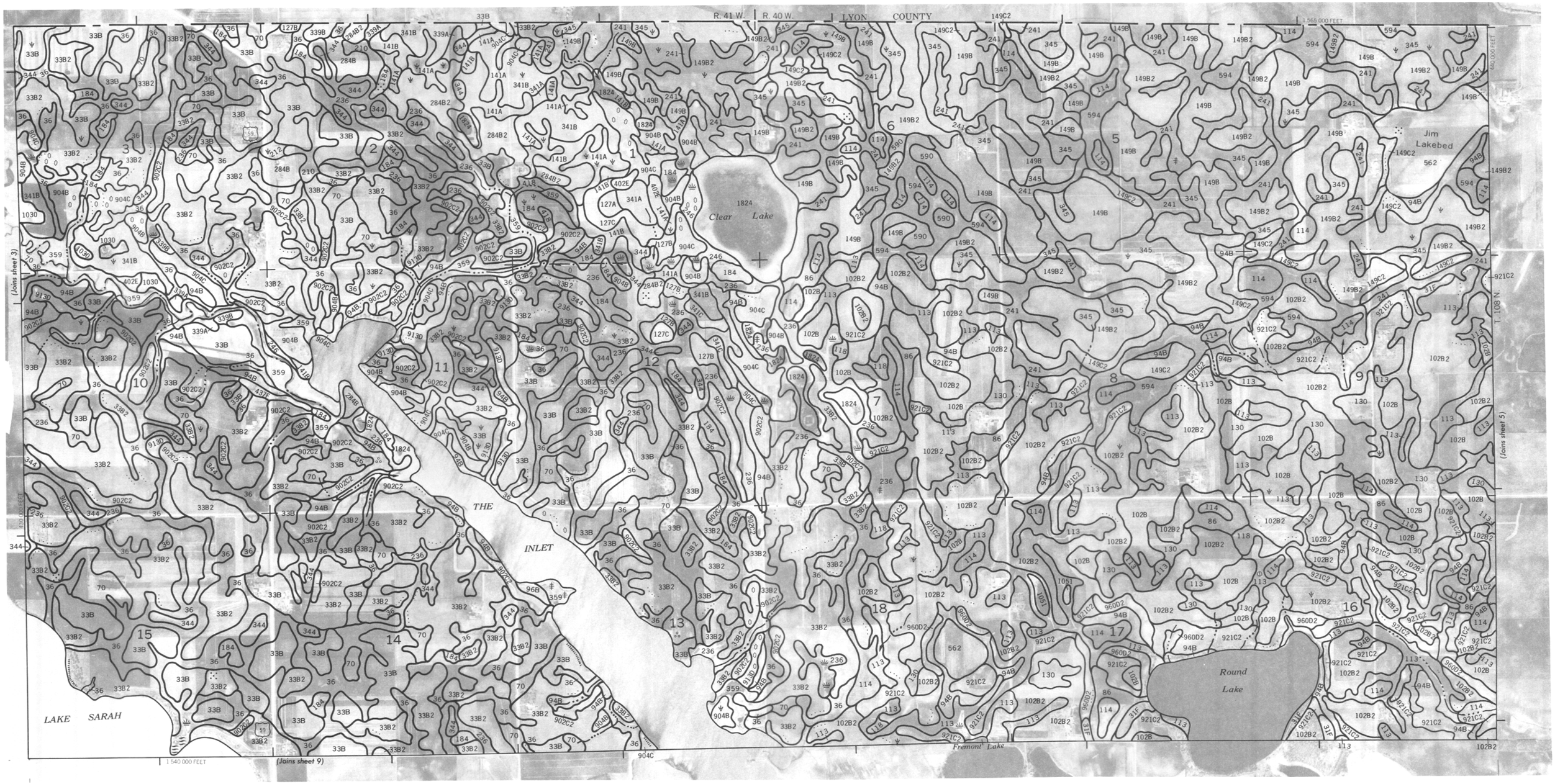


SOIL SURVEY OF MURRAY COUNTY, MINNESOTA - SHEET NUMBER 2

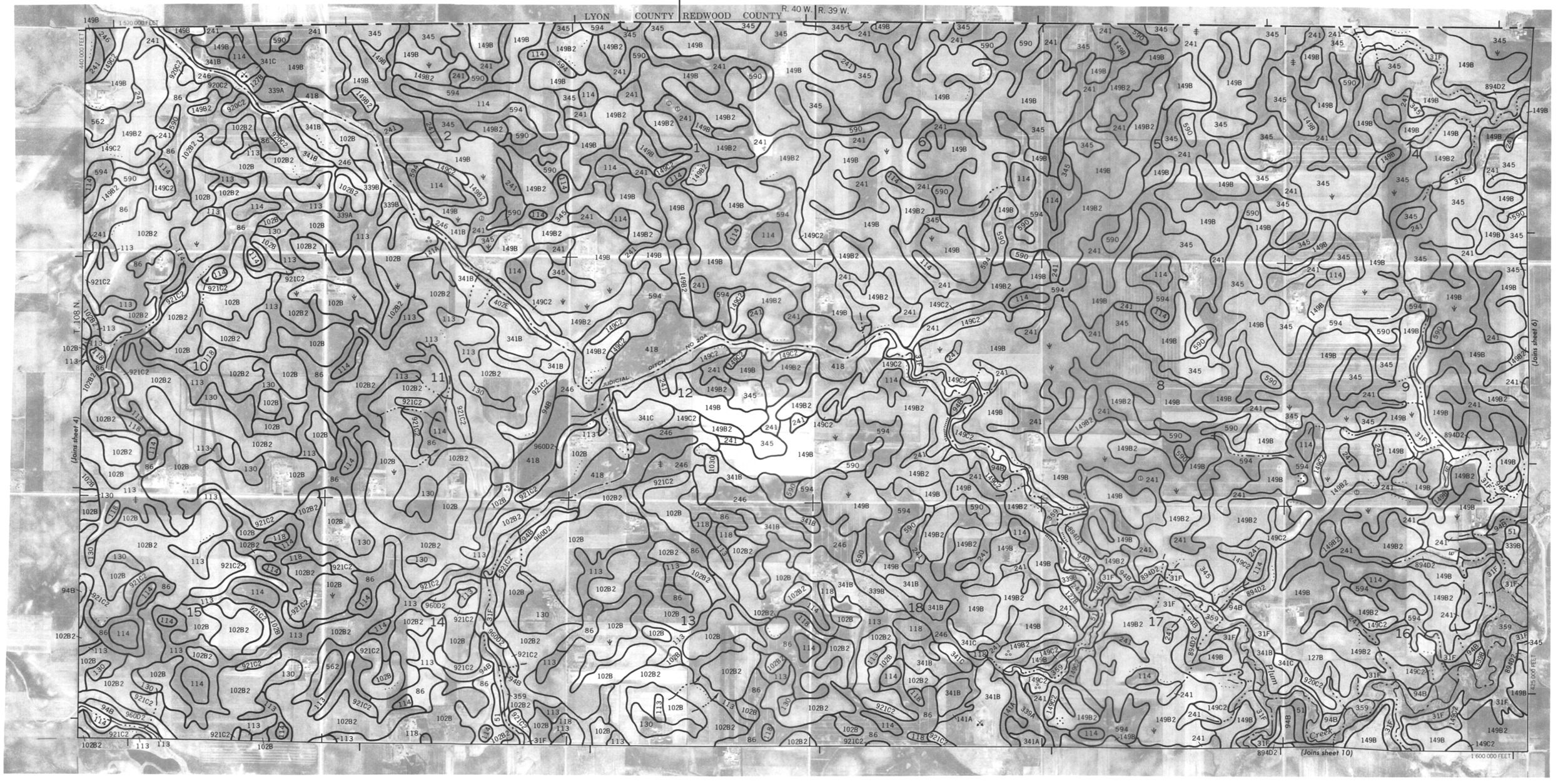


SOIL SURVEY OF MURRAY COUNTY, MINNESOTA - SHEET NUMBER 3




4
N
R. 41 W.
R. 40 W.
LYON COUNTY
T. 108 N.
Clear Lake
Jim Lakebed
THE INLET
LAKE SARAH
Round Lake
Fremont Lake
(Joins sheet 3)
(Joins sheet 5)
(Joins sheet 9)
1 565 000 FEET
1 540 000 FEET
440 000 FEET
430 000 FEET

SOIL SURVEY OF MURRAY COUNTY, MINNESOTA - SHEET NUMBER 5



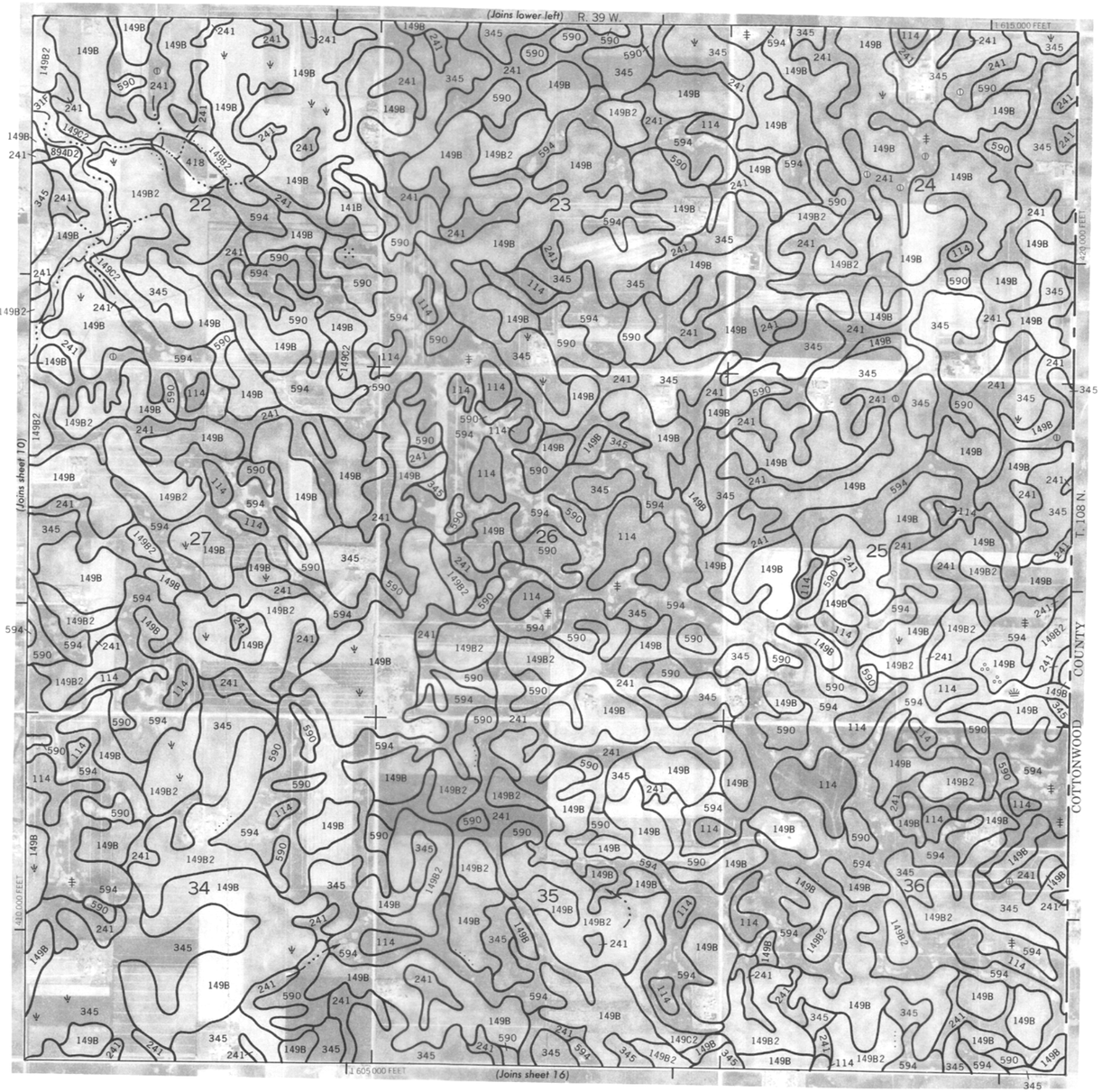

6
N
R. 39 W.
REDWOOD COUNTY
T. 108 N.
COTTONWOOD COUNTY
Creek
Plum
(Joins sheet 5)
(Joins inset)
615 000 FEET
600 FEET
605 000 FEET
625 000 FEET

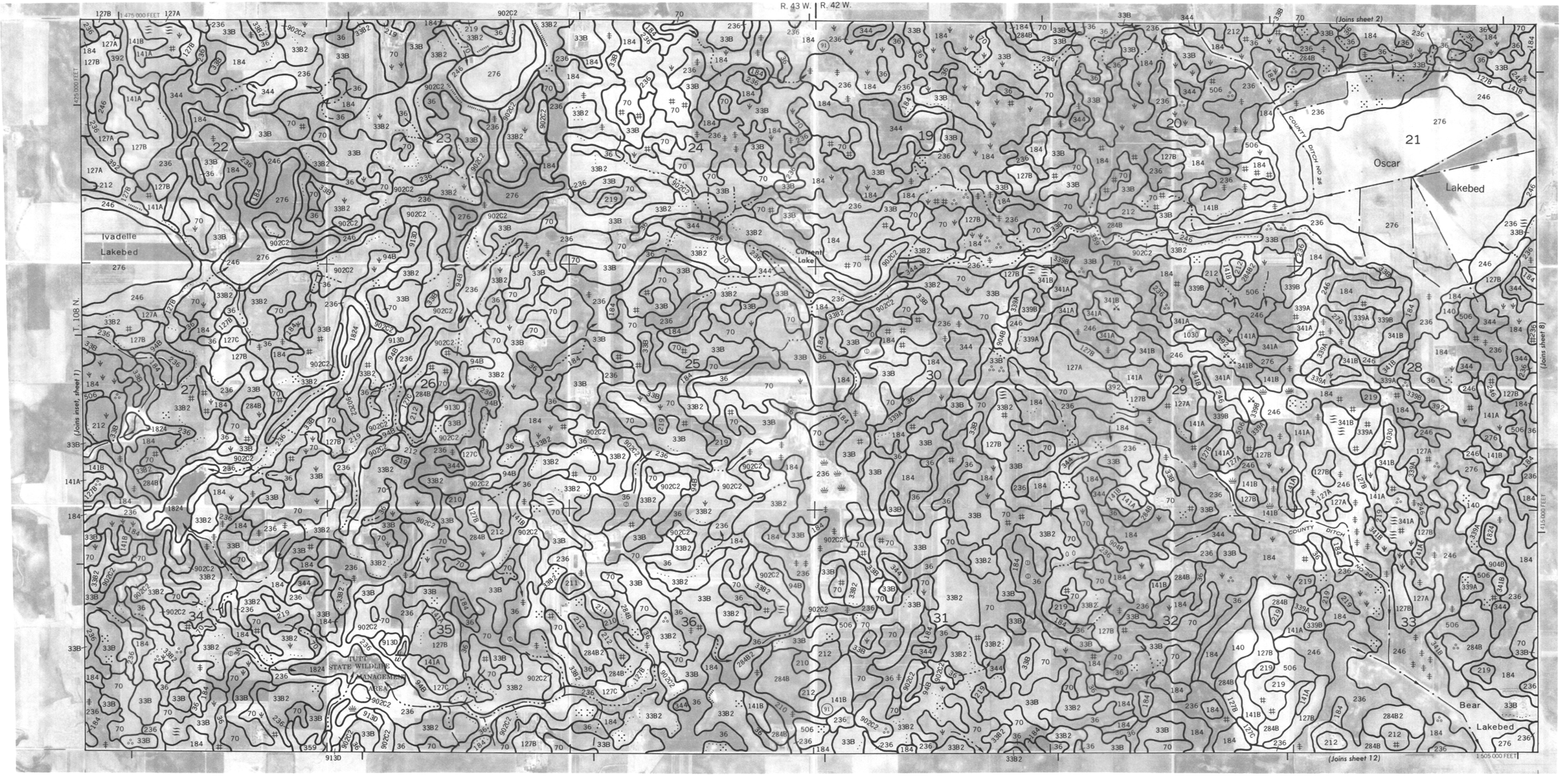

(Joins lower left)
R. 39 W.
(Joins sheet 10)
(Joins sheet 16)
COTTONWOOD COUNTY

6

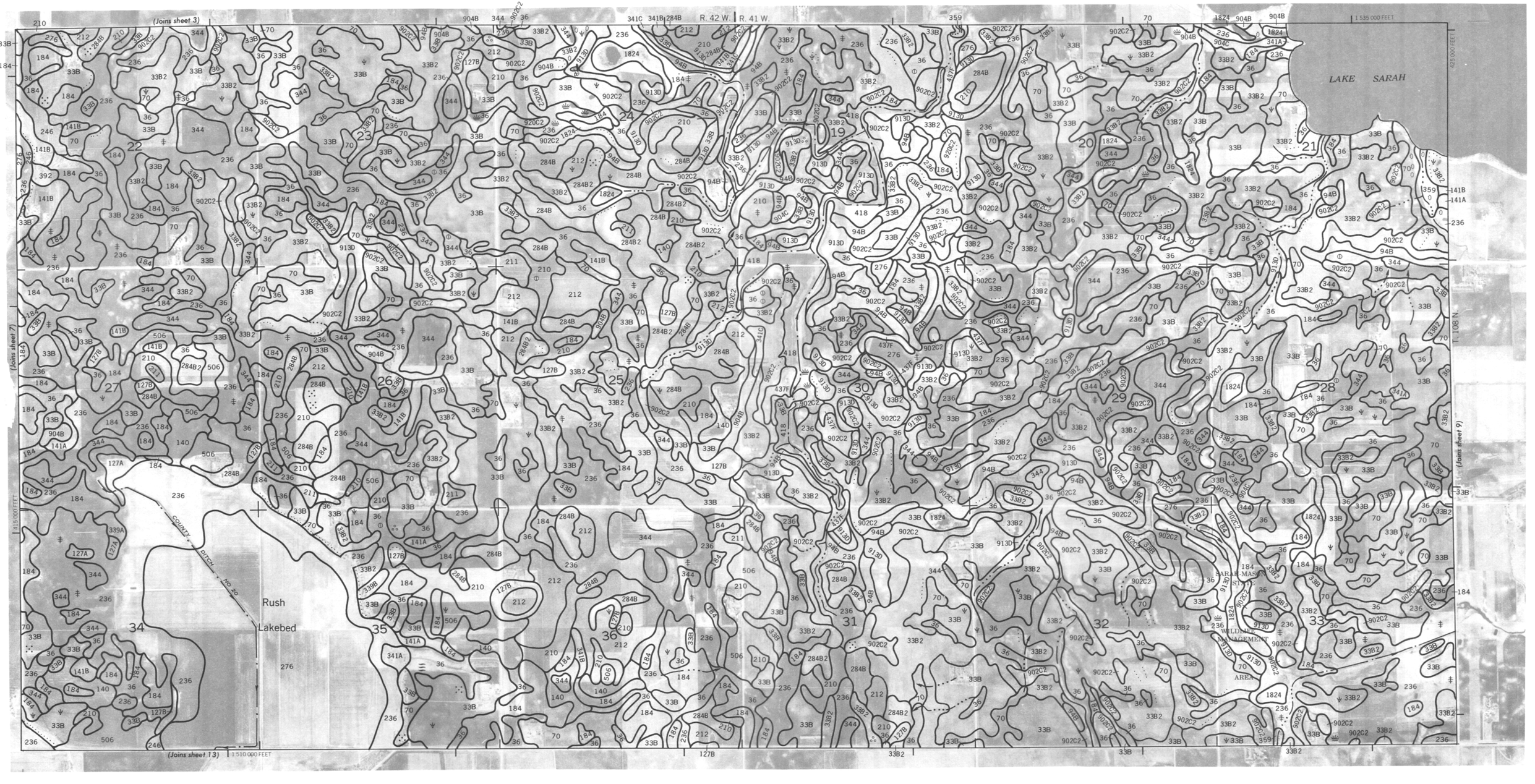
N

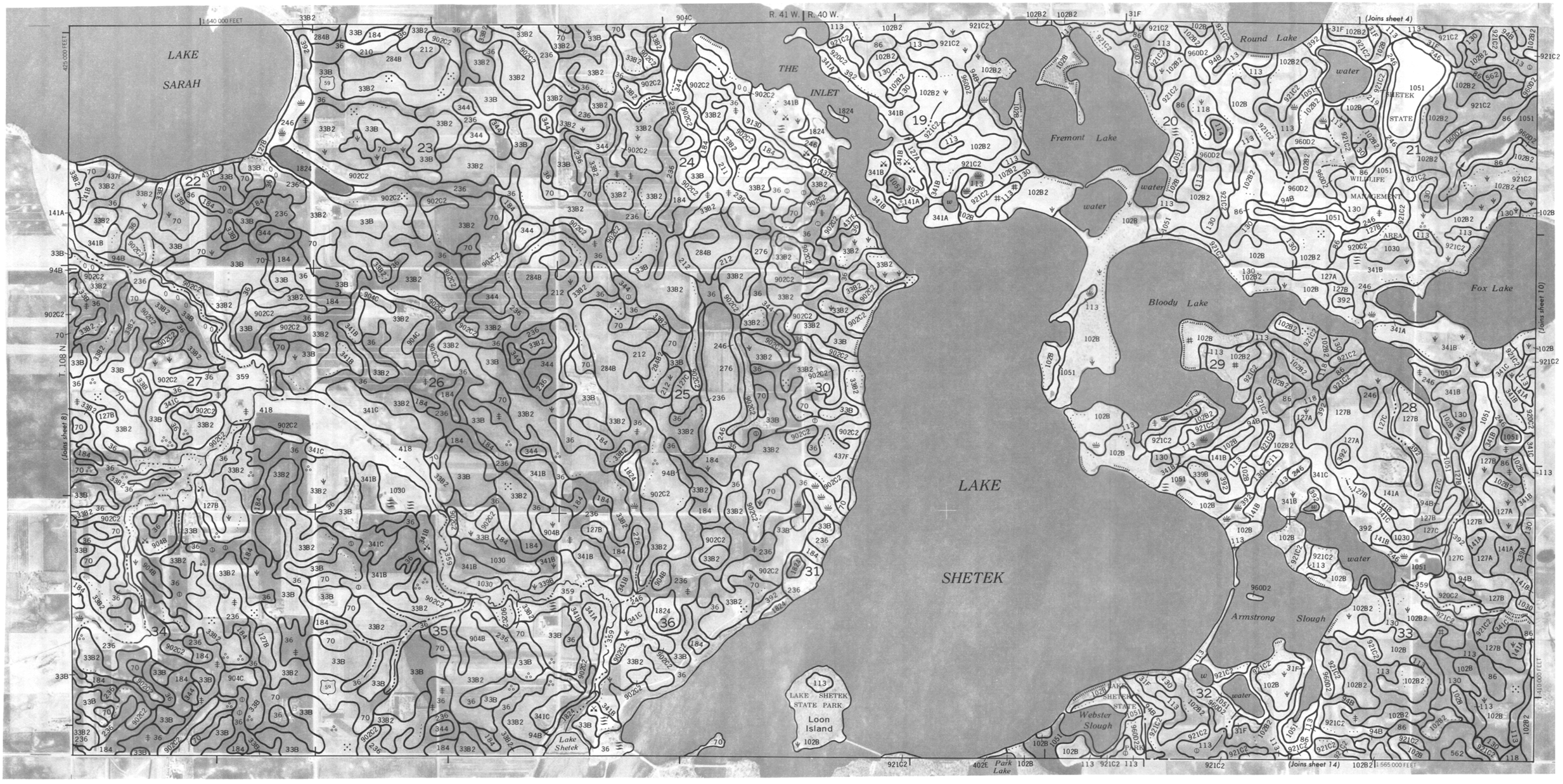

R. 39 W.
REDWOOD COUNTY
(Joins sheet 5)
(Joins inset)
1 600 000 FEET


(Joins lower left) R. 39 W.
1 615 000 FEET
420 000 FEET
(Joins sheet 10)
T. 108 N.
COTTONWOOD COUNTY
1 605 000 FEET
(Joins sheet 16)

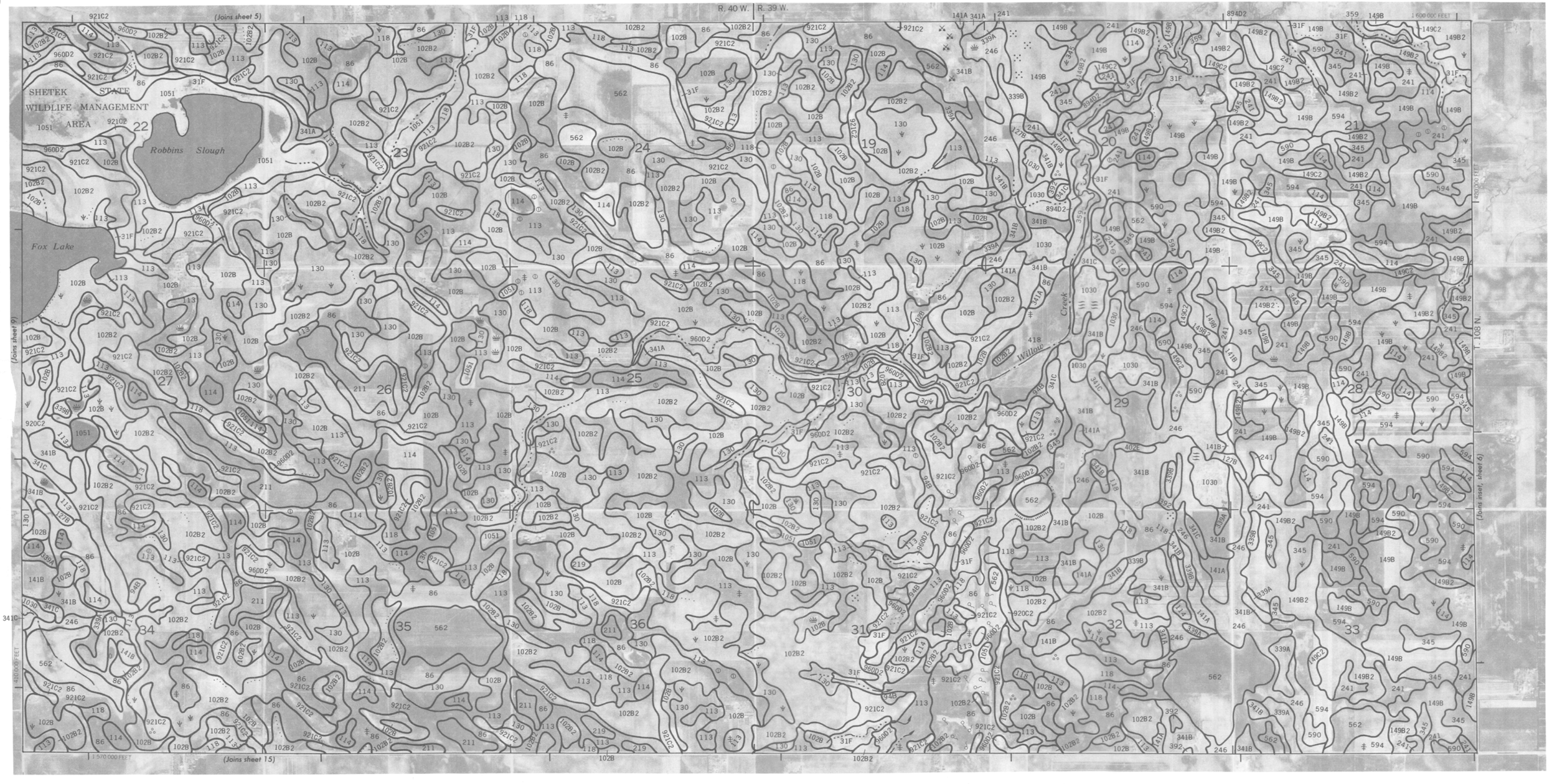

R. 43 W.
R. 42 W.
T. 108 N.
1 475 000 FEET
1 525 000 FEET
1 505 000 FEET
(Joins inset, sheet 1)
(Joins sheet 2)
(Joins sheet 8)
(Joins sheet 12)
Ivadelle
Lakebed
Current Lake
COUNTY DITCH NO 26
Oscar
Lakebed
COUNTY DITCH
TUTT STATE WILDLIFE MANAGEMENT AREA
Bear
Lakebed
N

SOIL SURVEY OF MURRAY COUNTY, MINNESOTA - SHEET NUMBER 8

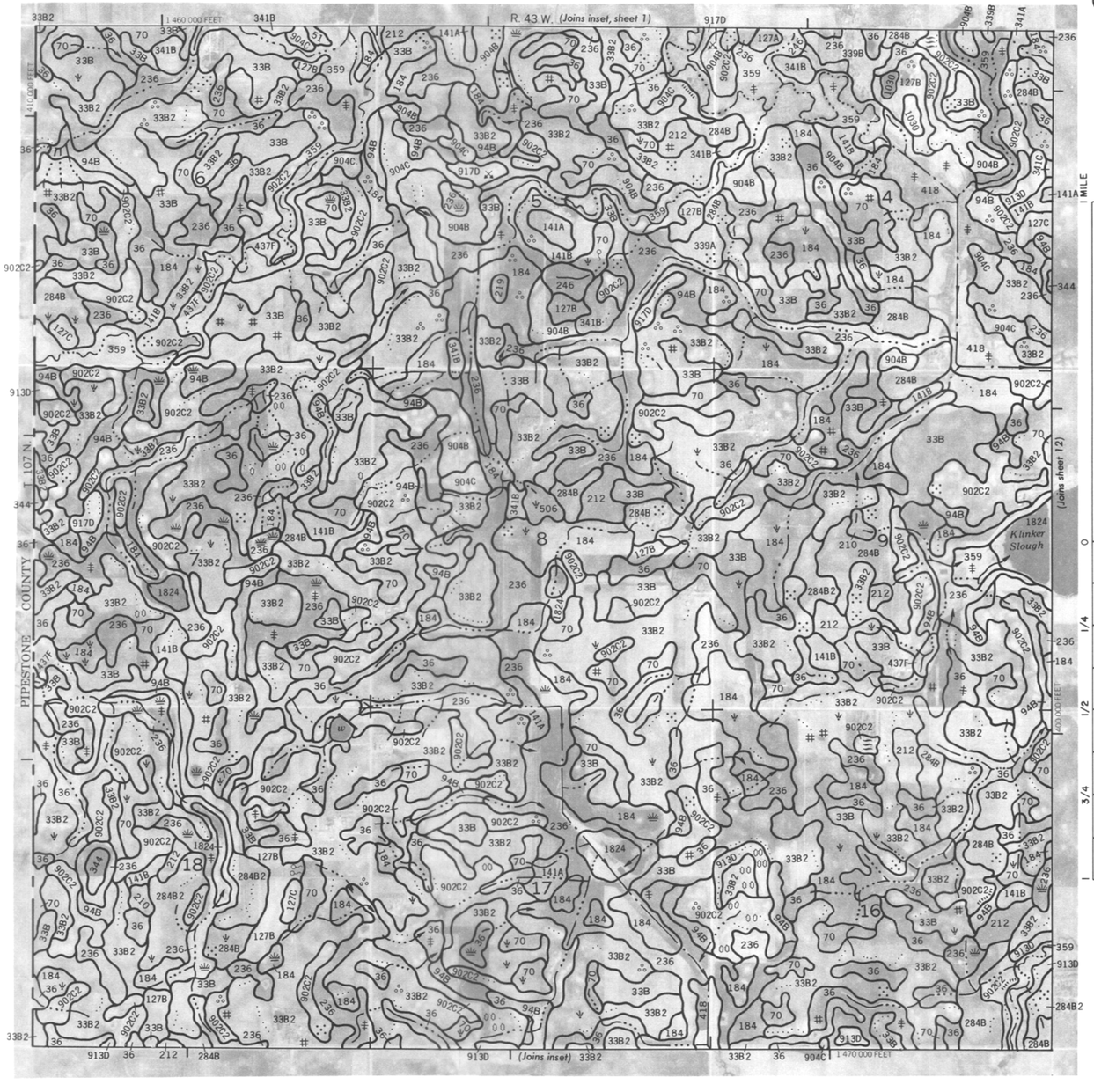



R. 41 W.
R. 40 W.
T. 108 N.
1:540 000 FEET
1:565 000 FEET
LAKE SARAH
THE INLET
Fremont Lake
Round Lake
water
Bloody Lake
Fox Lake
LAKE SHETEK
Armstrong Slough
Webster Slough
Loon Island
LAKE SHETEK STATE PARK
Lake Shetek
Park Lake
SHETEK STATE WILDLIFE MANAGEMENT AREA
(Joins sheet 4)
(Joins sheet 8)
(Joins sheet 10)
(Joins sheet 14)

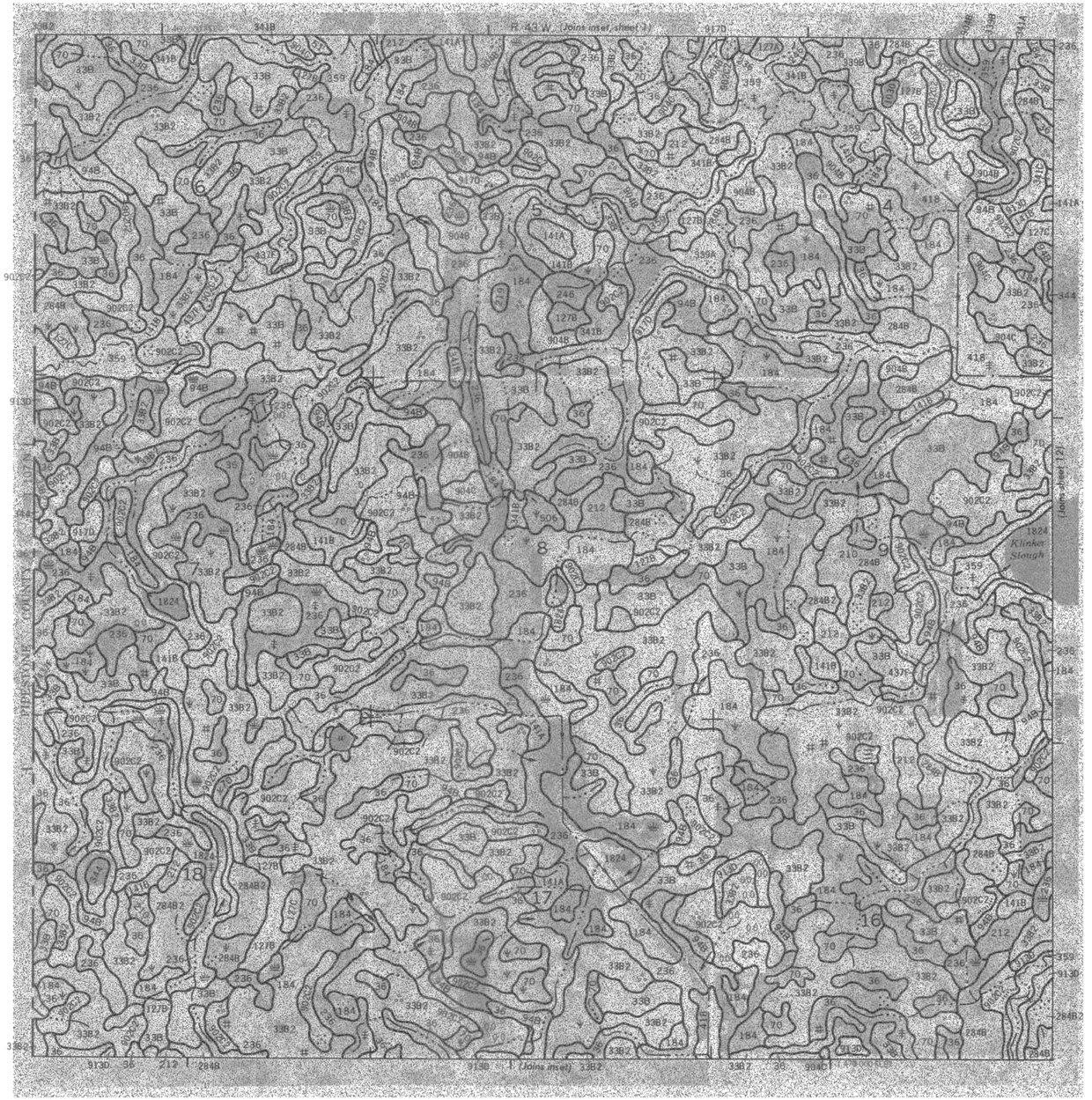
SOIL SURVEY OF MURRAY COUNTY, MINNESOTA - SHEET NUMBER 10



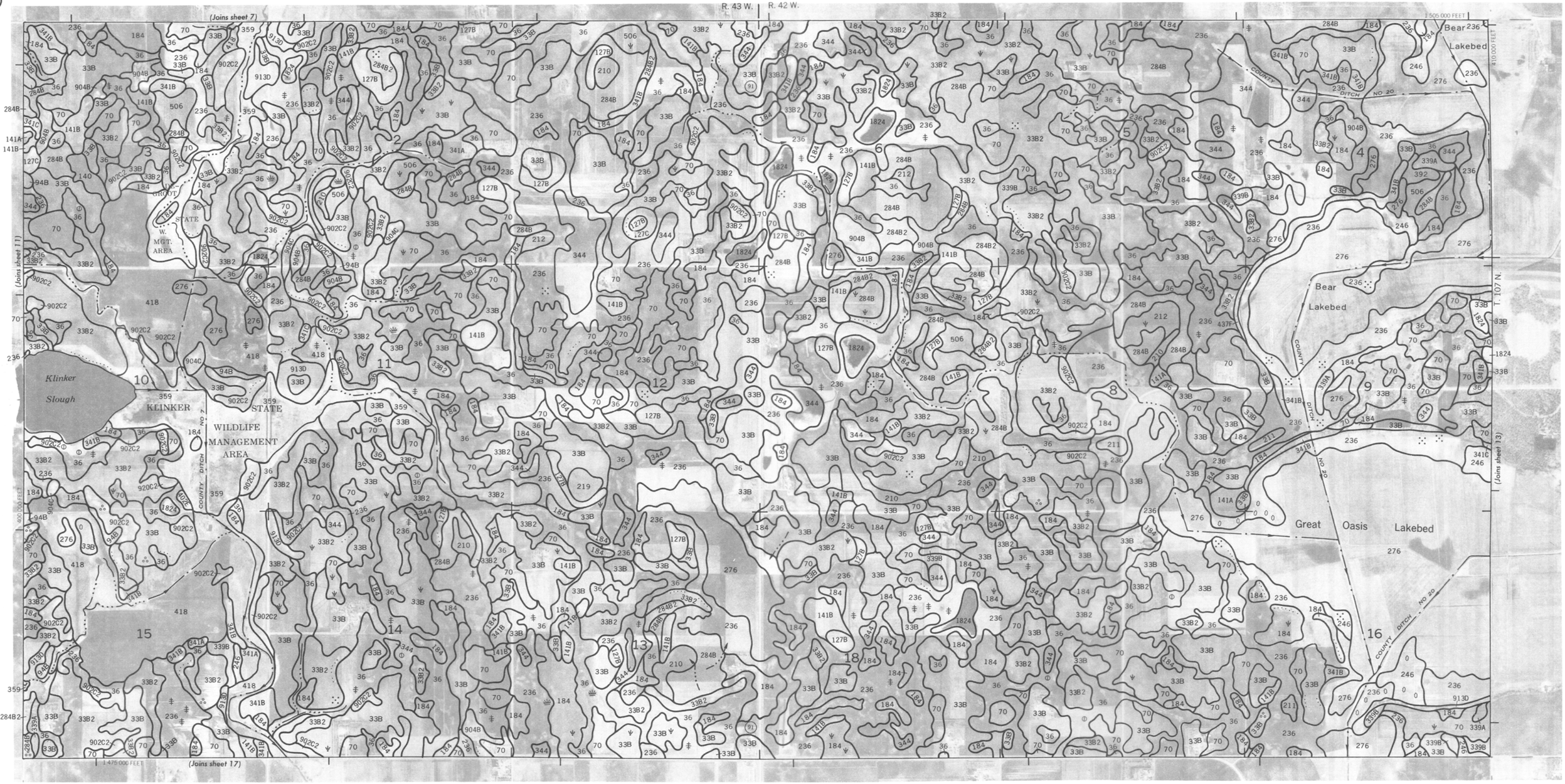

R. 43 W. (Joins flower right)
PIPESTONE COUNTY
MURRAY COUNTY, MINNESOTA SHEET 11
(Joins sheet 21)
(Joins sheet 12)

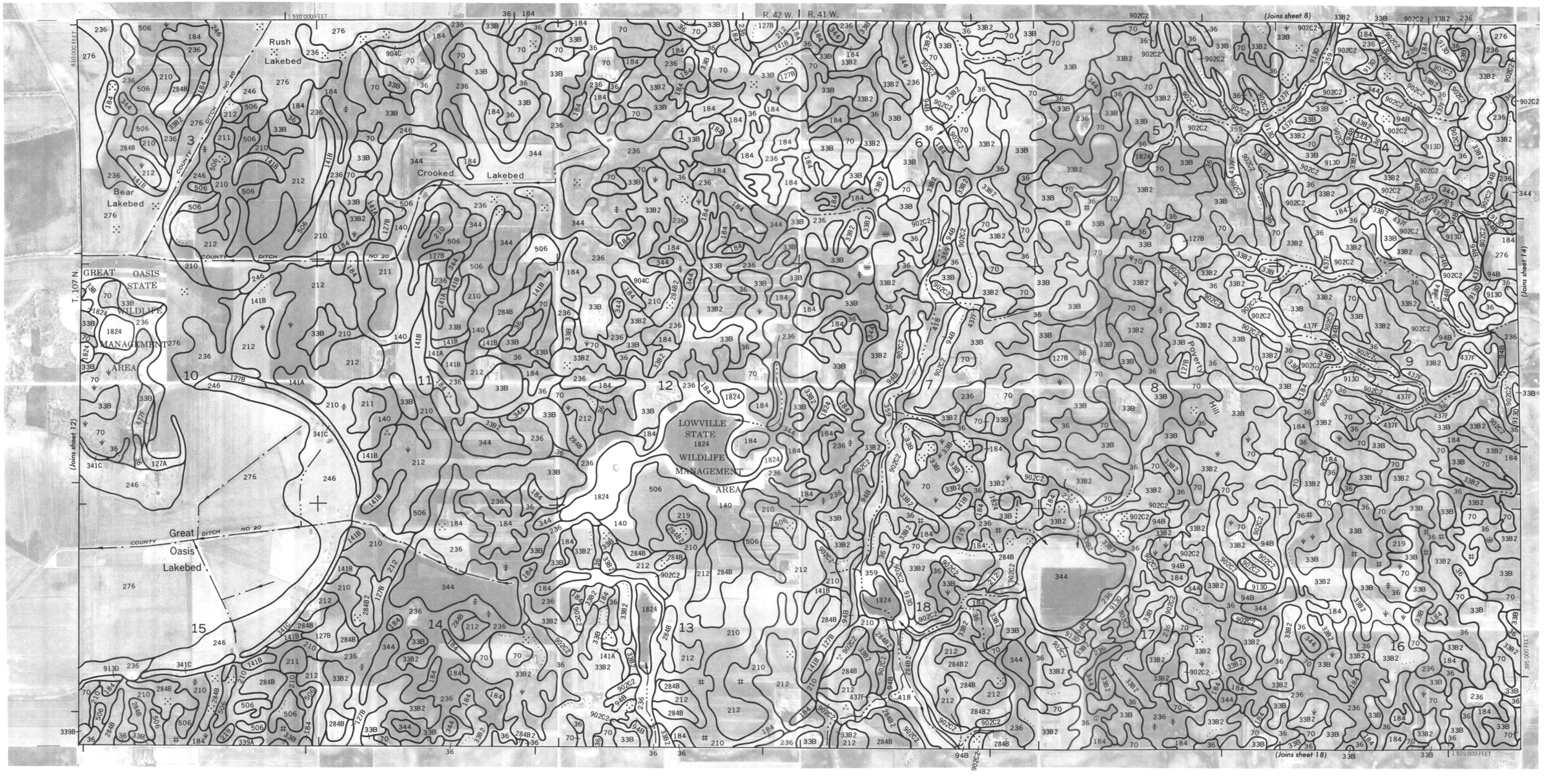

R. 43 W. (Joins inset, sheet 11)
PIPESTONE COUNTY
1 460 000 FEET
1 470 000 FEET
(Joins inset)
Klinker Slough
(Joins sheet 12)
11
N
1 MILE
1 KILOMETER

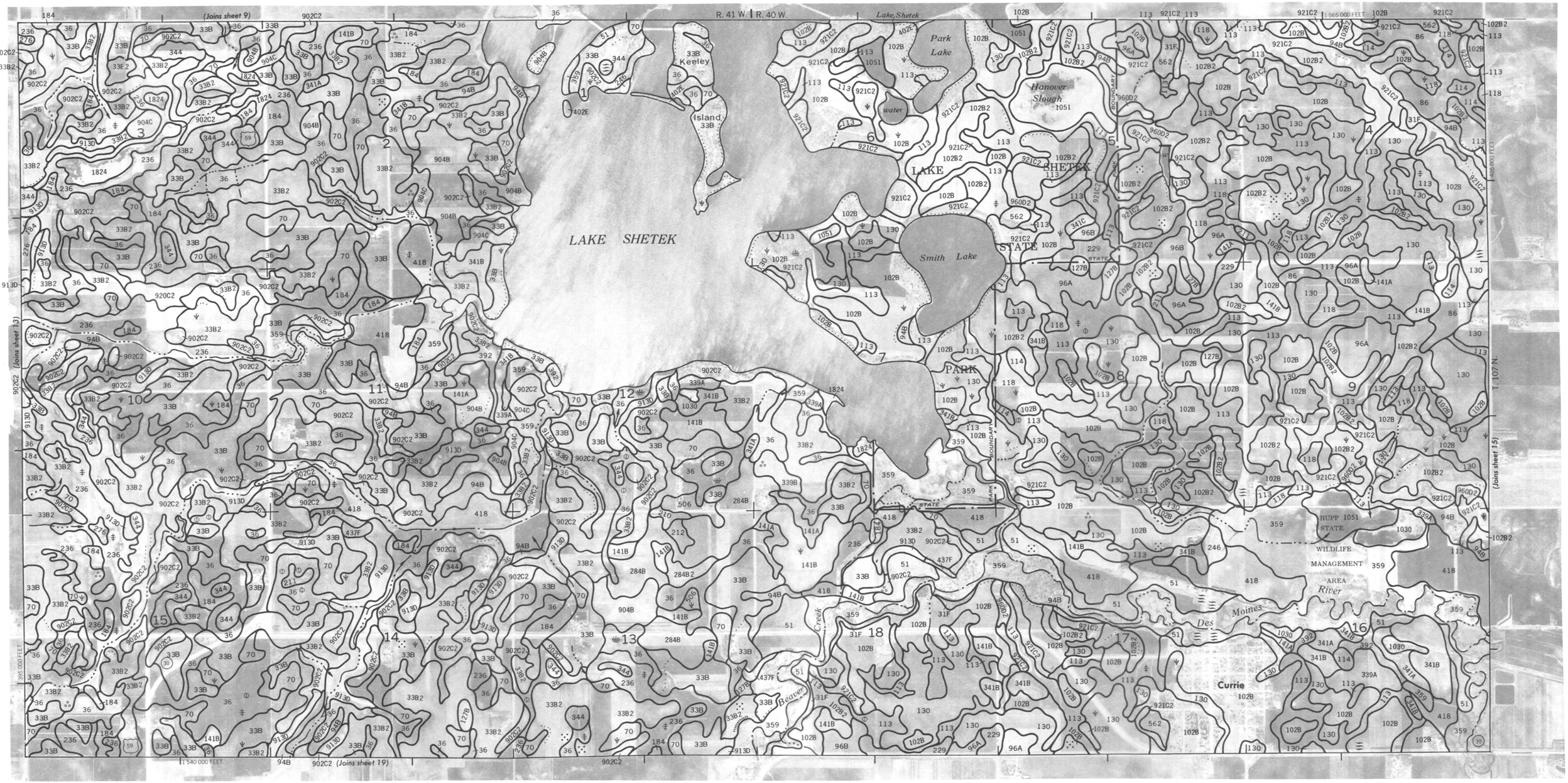

1 460 000 FEET
R. 43 W. (Joins lower right)
T. 107 N.
PIPESTONE COUNTY
MURRAY COUNTY, MINNESOTA
(Joins sheet 17)
(Joins sheet 21)
1 470 000 FEET
1 480 000 FEET

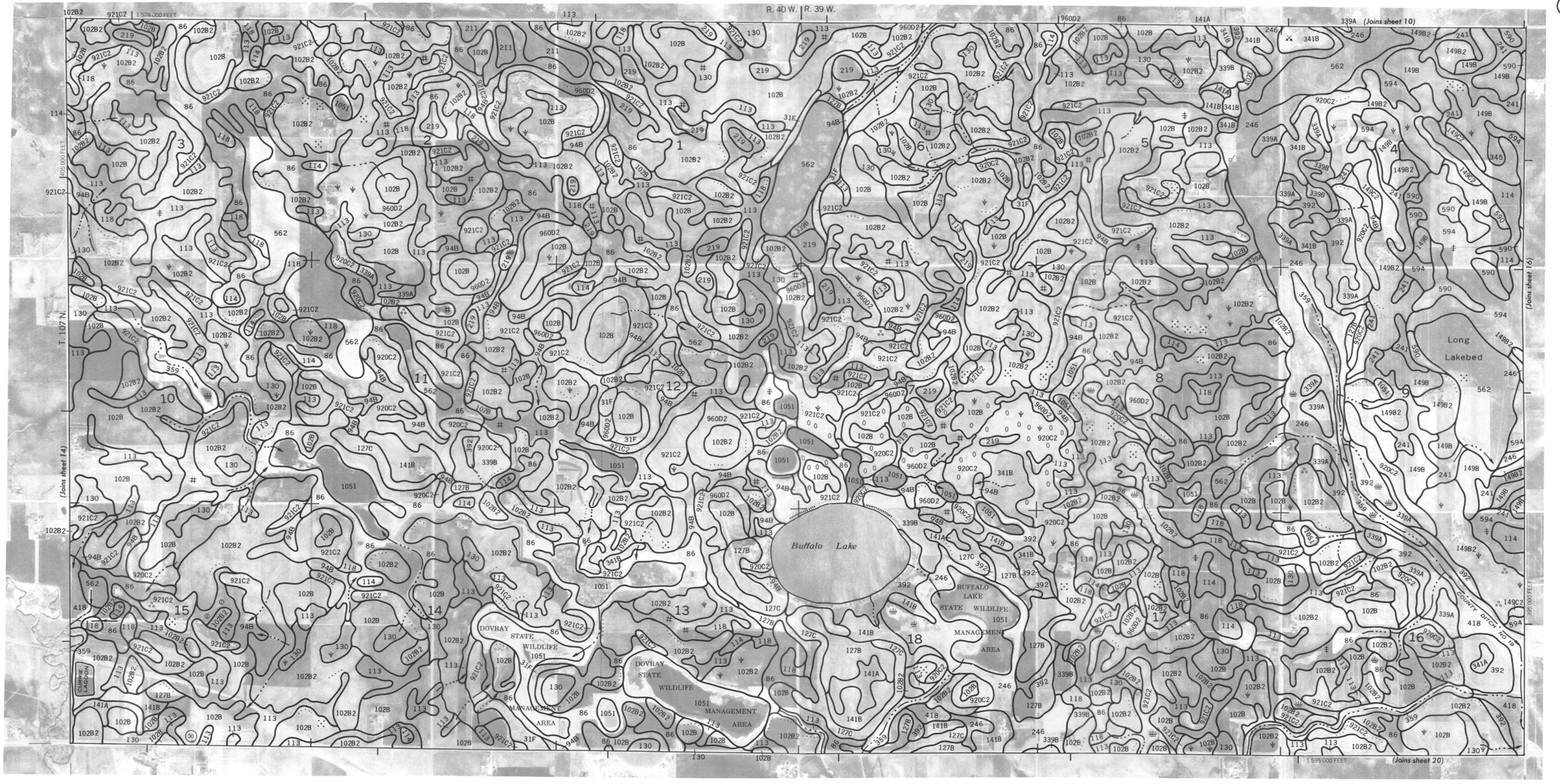

R. 43 W. (Joins inset, sheet 1)
PIPESTONE COUNTY
(Joins sheet 12)
(Joins inset)
Klinker Slough

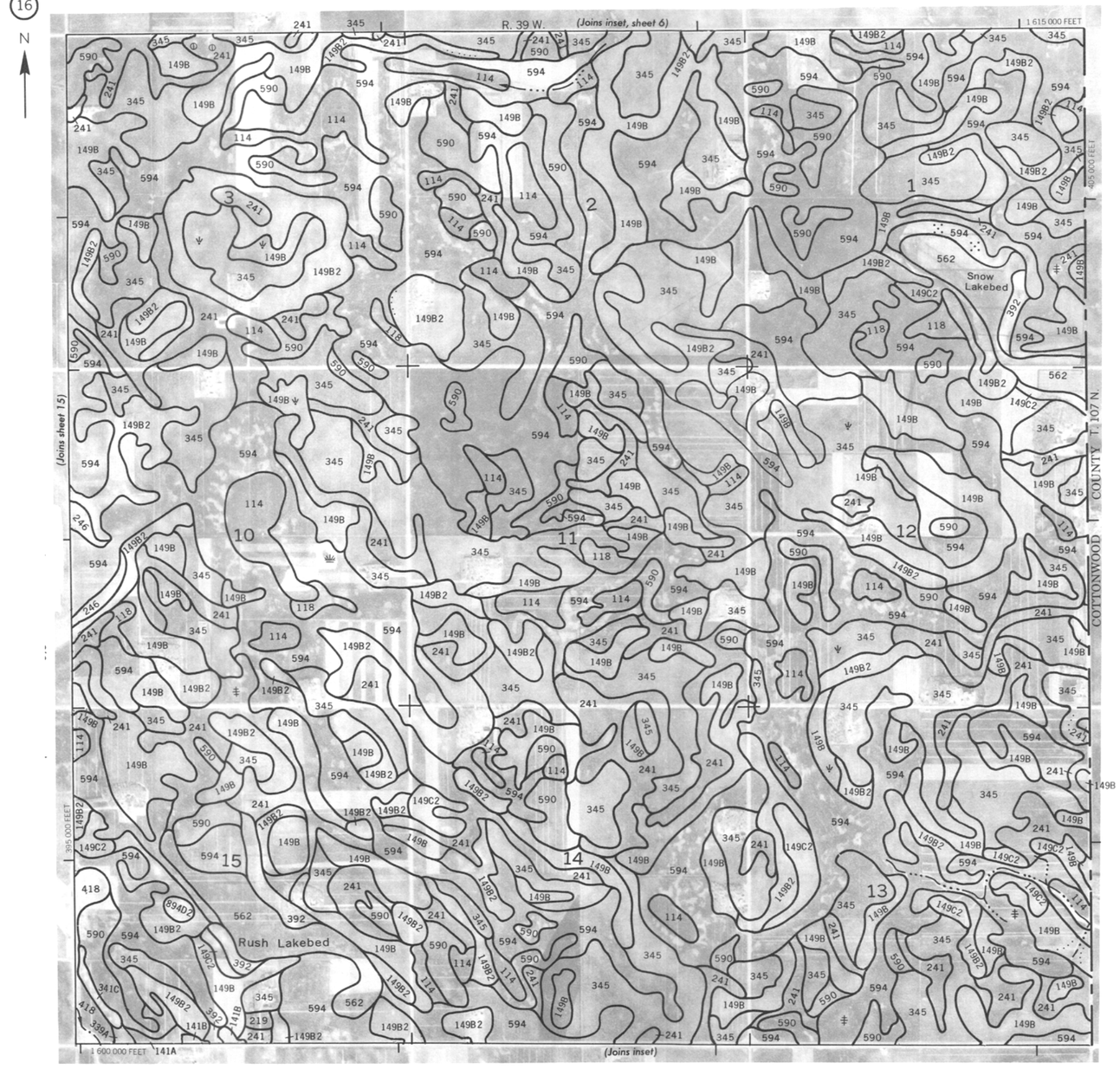
N


12
N
R. 43 W.
R. 42 W.
T. 107 N.
(Joins sheet 7)
(Joins sheet 11)
(Joins sheet 13)
(Joins sheet 17)
1 505 000 FEET
1 475 000 FEET
400 000 FEET
410 000 FEET
Klinker Slough
KLINKER STATE WILDLIFE MANAGEMENT AREA
STATE W. MGT. AREA
COUNTY DITCH NO 7
COUNTY DITCH NO 20
Bear Lakebed
Great Oasis Lakebed


R. 42 W.
R. 41 W.
T. 107 N.
1 510 000 FEET
410 000 FEET
385 000 FEET
1 535 000 FEET
(Joins sheet 8)
(Joins sheet 12)
(Joins sheet 14)
(Joins sheet 18)
Rush Lakebed
Crooked Lakebed
Bear Lakebed
Great Oasis Lakebed
GREAT OASIS STATE WILDLIFE MANAGEMENT AREA
LOWVILLE STATE 1824 WILDLIFE MANAGEMENT AREA
COUNTY DITCH NO 20
Great COUNTY DITCH NO 20
Powers Hill
N

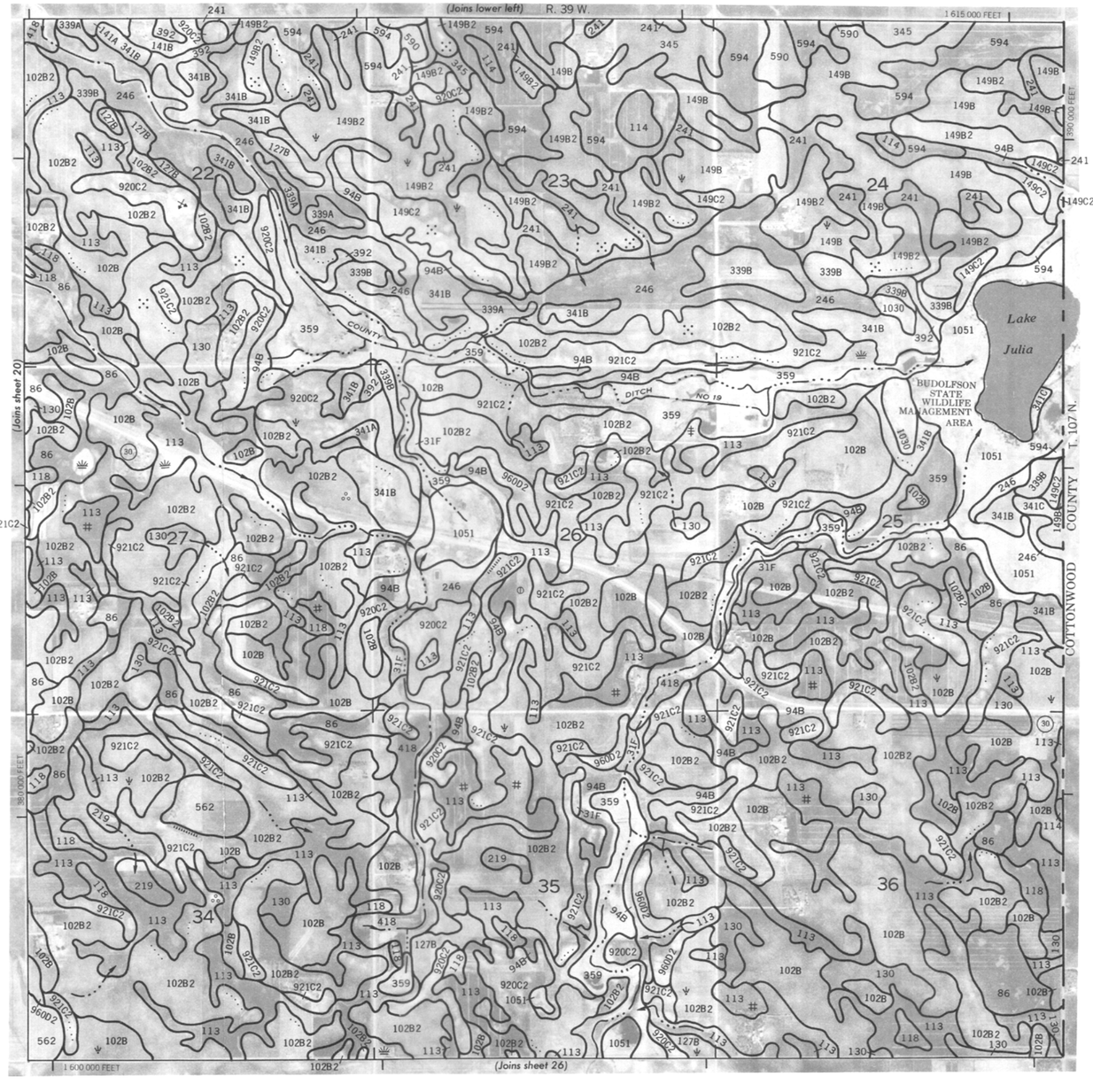

14
N
(Joins sheet 9)
R. 41 W.
R. 40 W.
Lake Shetek
LAKE SHETEK
Keeley Island
Park Lake
Hanover Slough
Smith Lake
SHETEK STATE PARK
PARK BOUNDARY
RUPP STATE WILDLIFE MANAGEMENT AREA
Des Moines River
Beaver Creek
Currie
(Joins sheet 13)
(Joins sheet 15)
(Joins sheet 19)
T. 107 N.
1 565 000 FEET
1 540 000 FEET
395 000 FEET
405 000 FEET

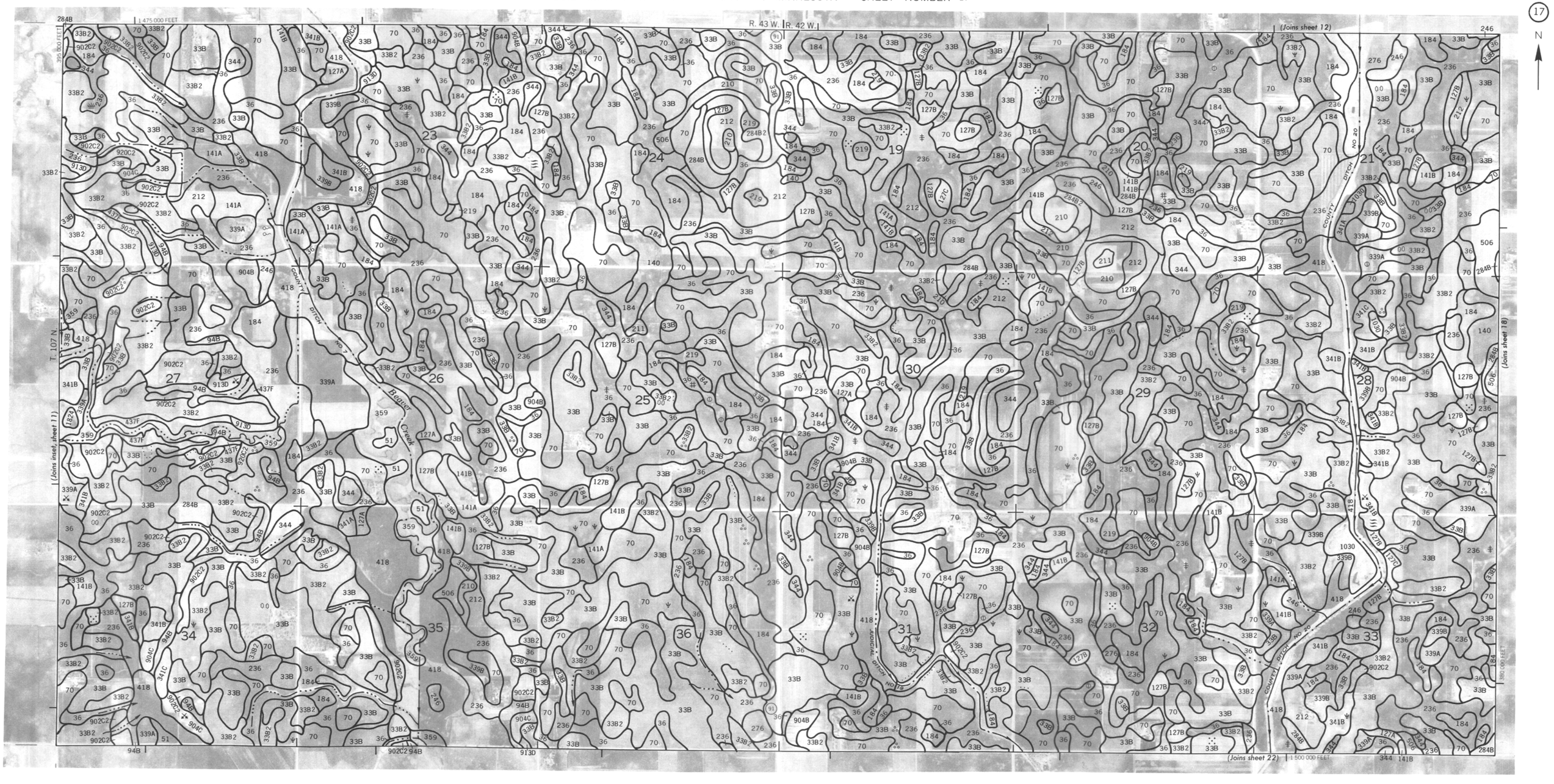

R. 40 W.
R. 39 W.
T. 107 N.
1 579 000 FEET
1 595 000 FEET
405 000 FEET
395 000 FEET
(Joins sheet 10)
(Joins sheet 14)
(Joins sheet 16)
(Joins sheet 20)
Buffalo Lake
Long Lakebed
DOVRAY STATE WILDLIFE MANAGEMENT AREA
BUFFALO LAKE STATE WILDLIFE MANAGEMENT AREA
COUNTY DITCH NO 78
CURRIE LAGOON
N

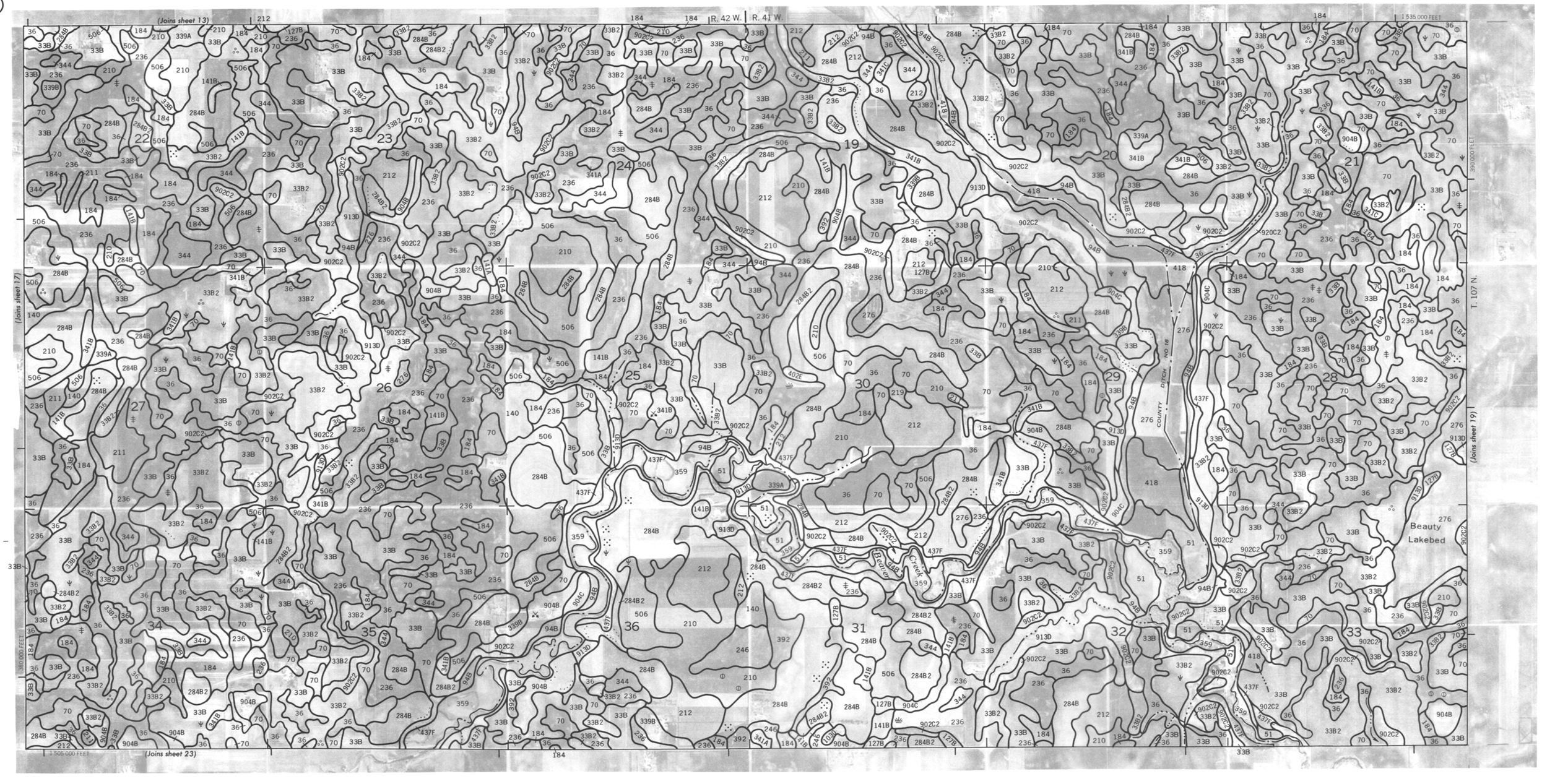

16
N
R. 39 W.
(Joins inset, sheet 6)
1 615 000 FEET
(Joins sheet 15)
COTTONWOOD COUNTY
T. 107 N.
Snow Lakebed
Rush Lakebed
1 600 000 FEET
141A
(Joins inset)

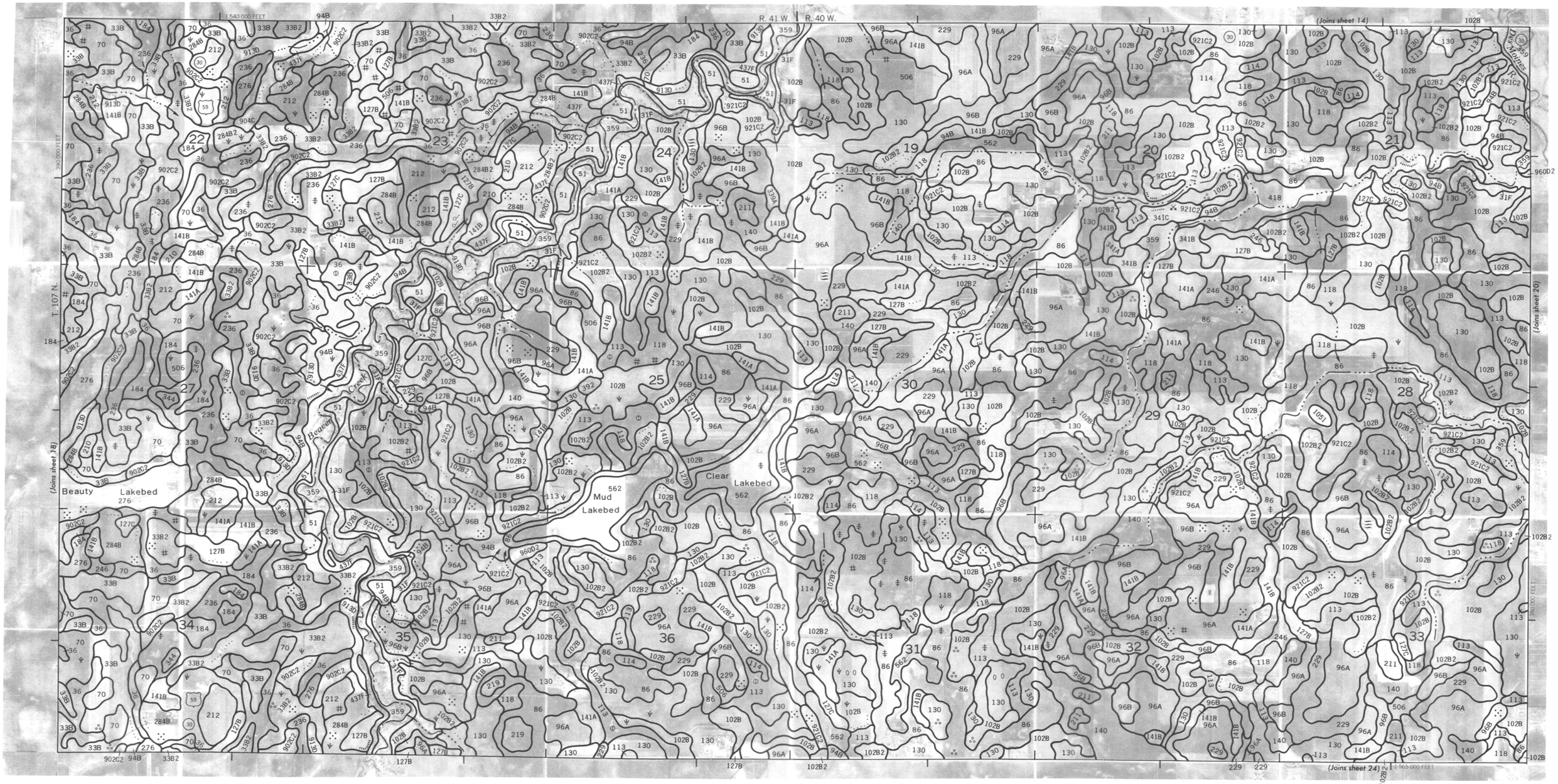

(Joins lower left)
R. 39 W.
Lake Julia
(Joins sheet 26)

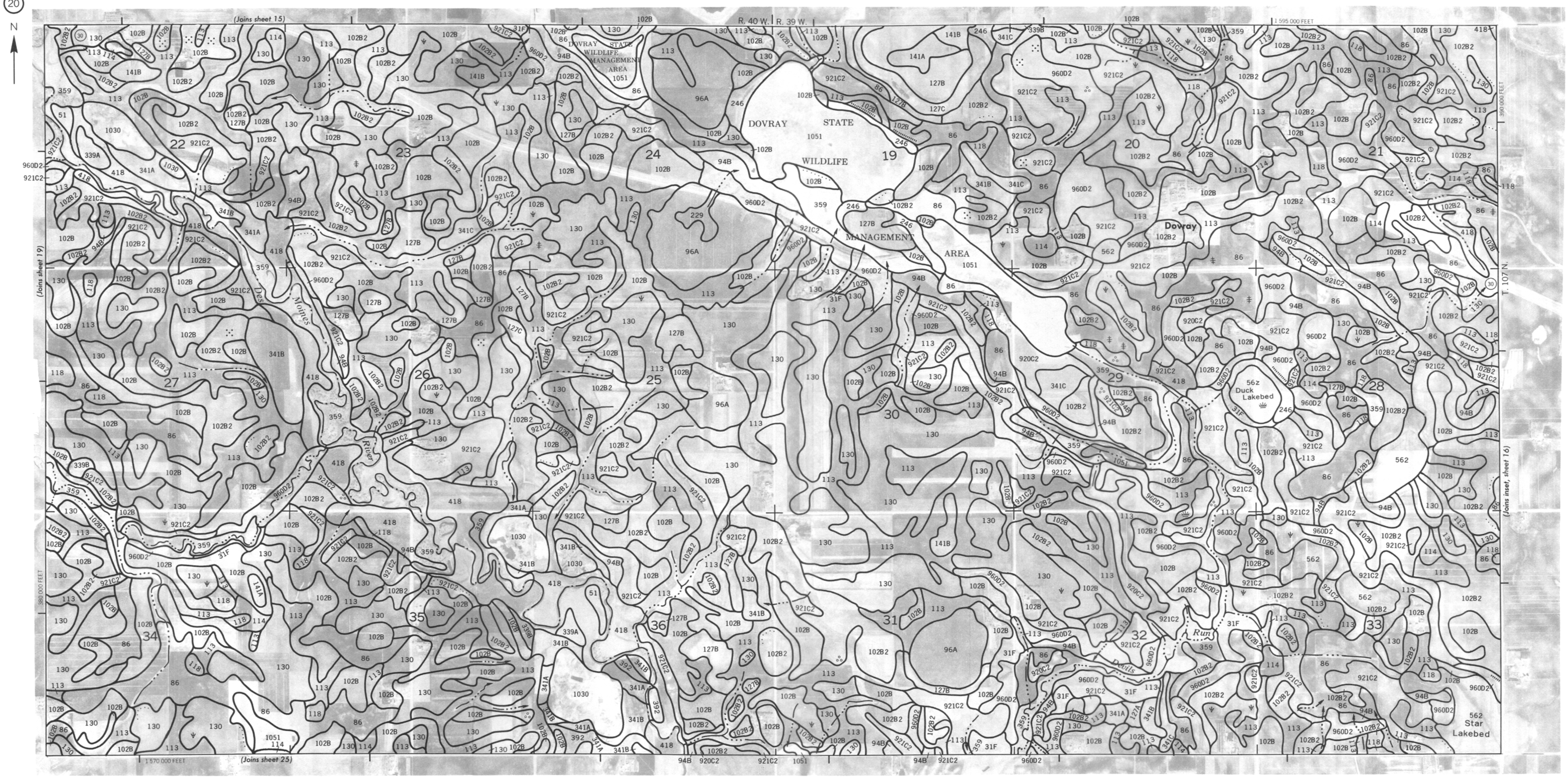

16
N
R. 39 W.
(Joins inset, sheet 6)
(Joins inset)
(Joins sheet 15)
Snow Lakebed
Rush Lakebed
COTTONWOOD COUNTY
T. 107 N.
1615000 FEET
1600000 FEET


(Joins lower left)
R. 39 W.
(Joins sheet 20)
(Joins sheet 26)
Lake Julia
BUDOLFSON STATE WILDLIFE MANAGEMENT AREA
DITCH NO 19
COUNTY
COTTONWOOD COUNTY
T. 107 N.
1615000 FEET
1600000 FEET
960000 FEET


17
N
R. 43 W.
R. 42 W.
T. 107 N.
(Joins sheet 12)
(Joins inset, sheet 11)
(Joins sheet 18)
(Joins sheet 22)
1 475 000 FEET
1 500 000 FEET
396 000 FEET
380 000 FEET
COUNTY DITCH NO 7
COUNTY DITCH NO 20
Beaver Creek
Woodlawn Ditch No 18


18
N
(Joins sheet 13)
R. 42 W.
R. 41 W.
1 535 000 FEET
380 000 FEET
T. 107 N.
(Joins sheet 17)
(Joins sheet 19)
(Joins sheet 23)
1 505 000 FEET
COUNTY DITCH NO 18
Beauty Lakebed
Squaw Creek


R. 41 W.
R. 40 W.
T. 107 N.
1 540 000 FEET
1 565 000 FEET
390 000 FEET
960D2
(Joins sheet 14)
(Joins sheet 18)
(Joins sheet 20)
(Joins sheet 24)
Beauty Lakebed
Mud Lakebed
Clear Lakebed
Beaver Creek
Des Moines R.
N


20
N
(Joins sheet 15)
(Joins sheet 19)
(Joins sheet 25)
(Joins inset, sheet 16)
R. 40 W.
R. 39 W.
T. 107 N.
1 595 000 FEET
1 570 000 FEET
390 000 FEET
380 000 FEET
DOVRAY STATE WILDLIFE MANAGEMENT AREA
Dovray
Des Moines River
Duck Lakebed
Star Lakebed
Devils Run

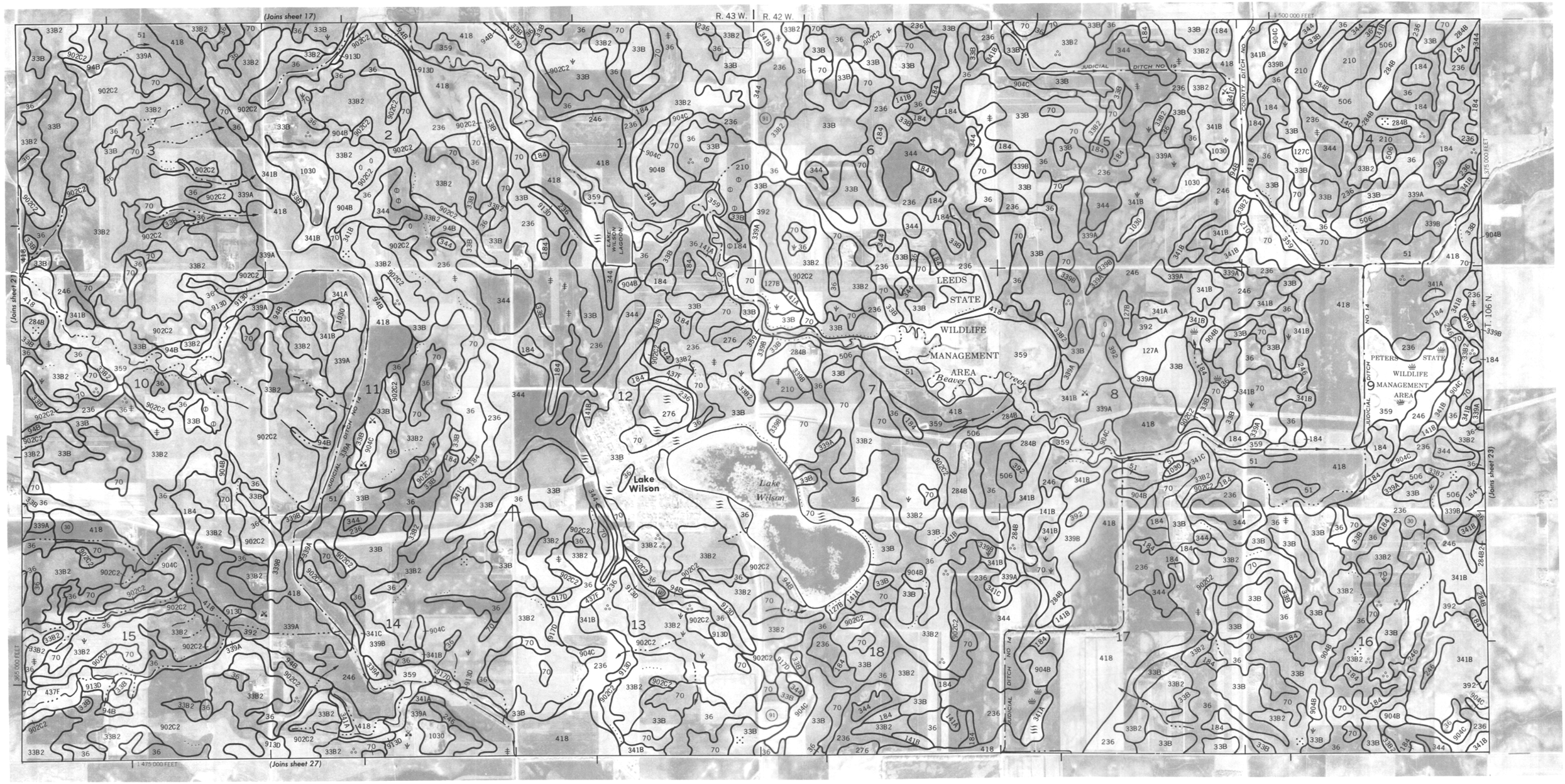

R. 43 W.
(Joins sheet 11)
(Joins sheet 31)
T. 106 N.
PIPESTONE COUNTY
Chiquaramine Creek
North Branch
BUFFALO RIDGE

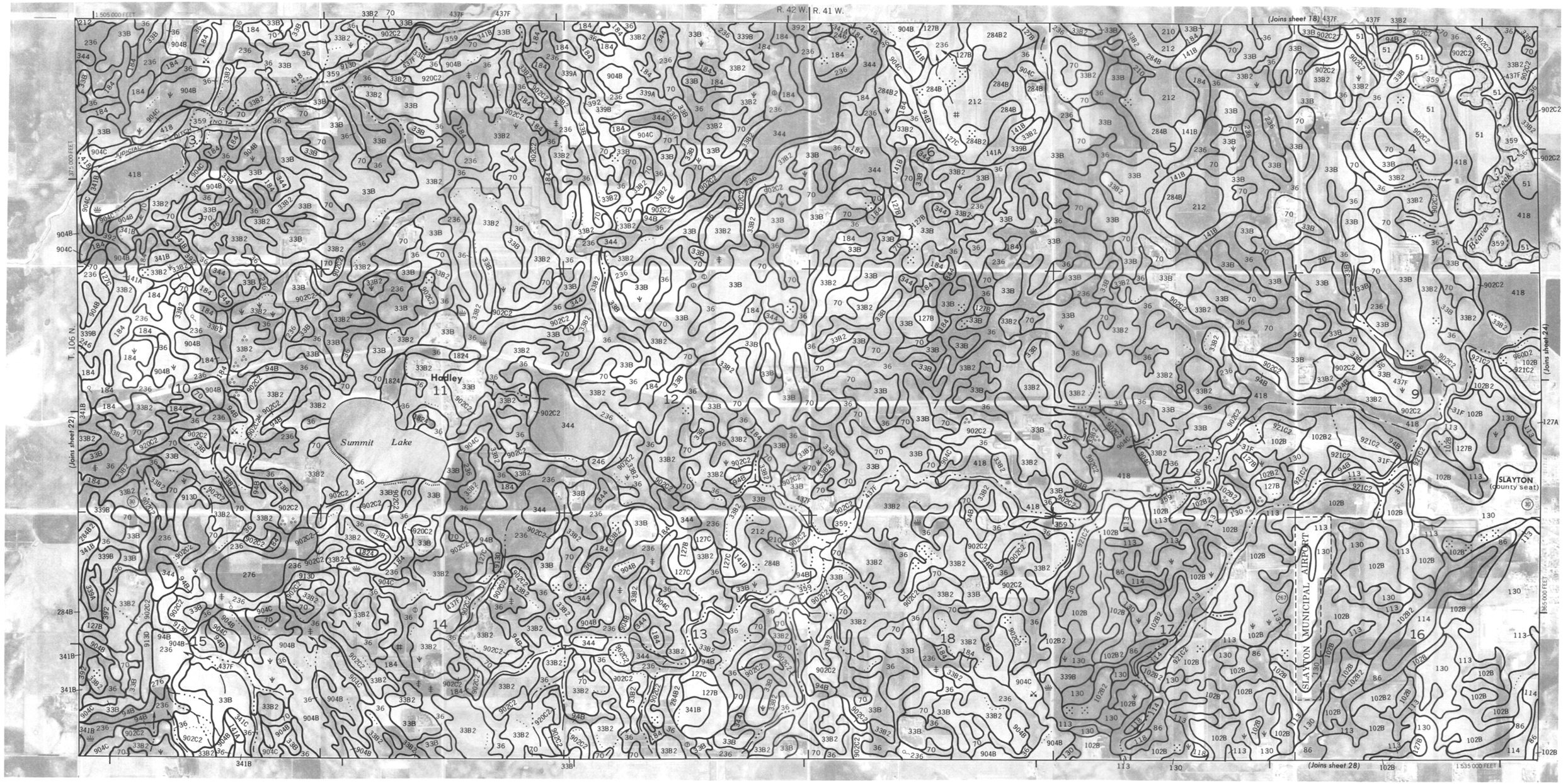

1 460 000 FEET
R. 43 W.
(Joins inset, sheet 11)
(Joins sheet 22)
(Joins inset)
1 470 000 FEET
375 000 FEET
365 000 FEET
T. 106 N.
PIPESTONE COUNTY
Chiquaramine Creek
North Branch
BUFFALO RIDGE

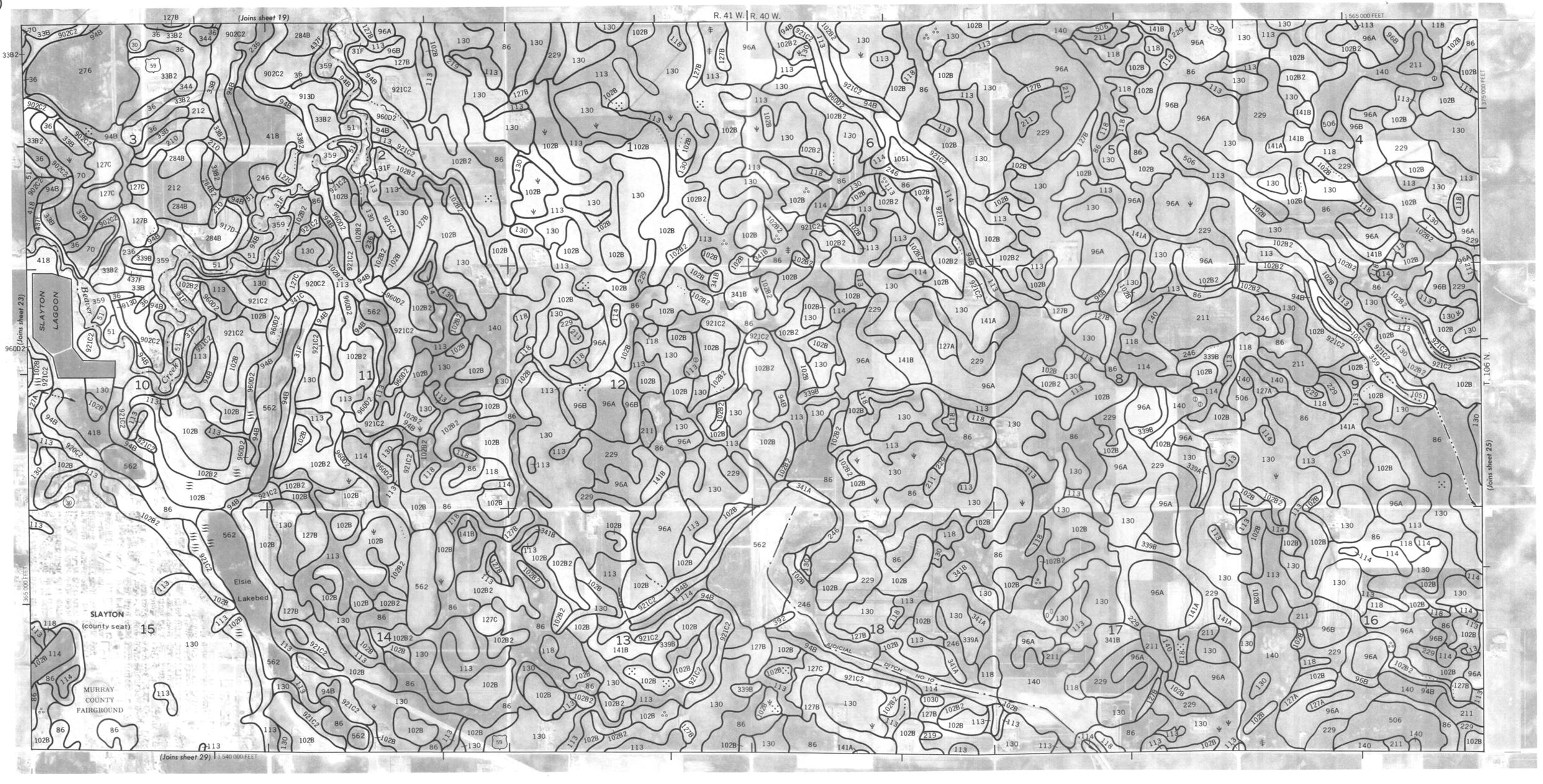
N

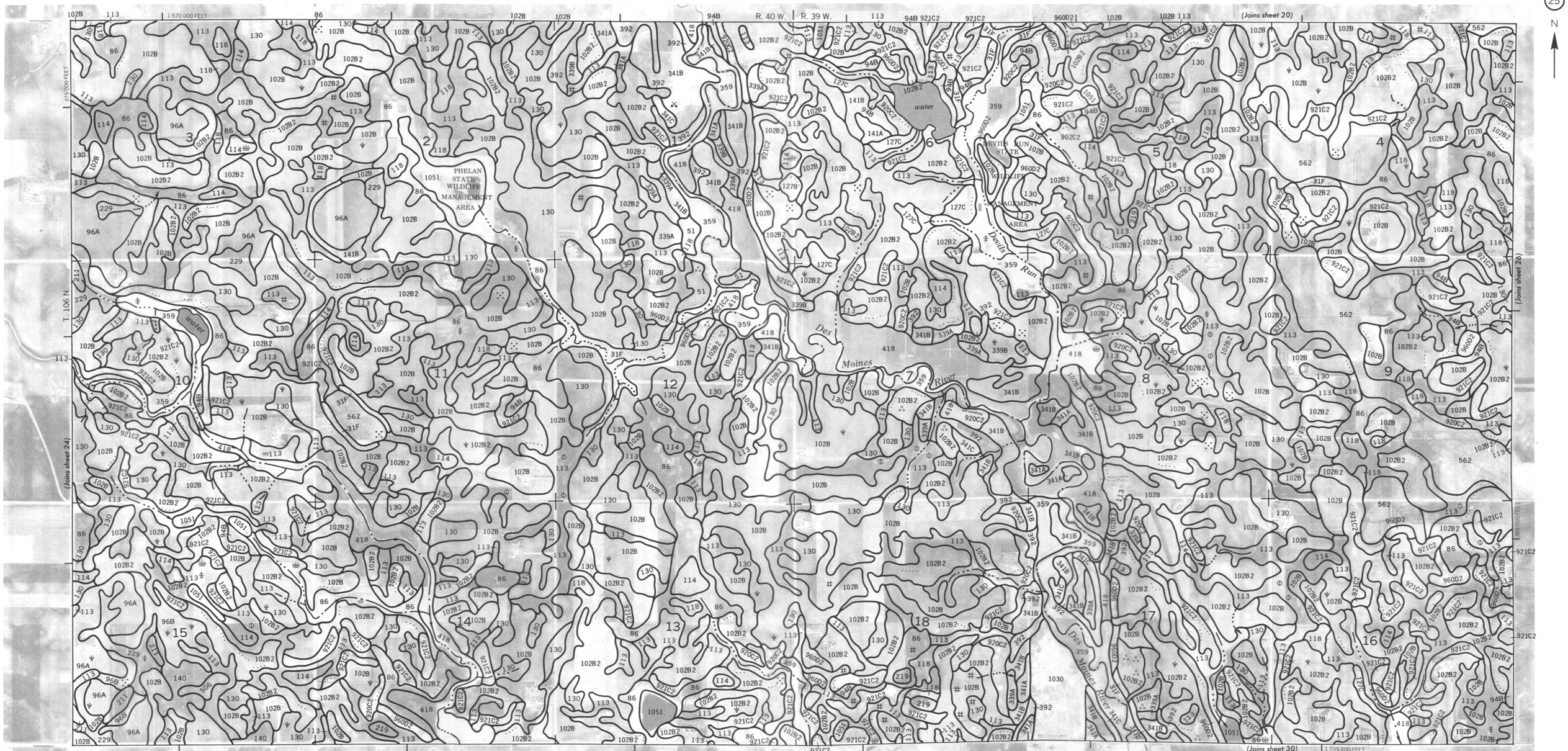

R. 43 W.
297B (Joins lower right)
(Joins sheet 31)
(Joins sheet 27)
PIPESTONE COUNTY
T. 106 N
BUFFALO RIDGE
North Prairie Creek
Prairie Creek
1 460 000 FEET
1 470 000 FEET
360 000 FEET
350 000 FEET

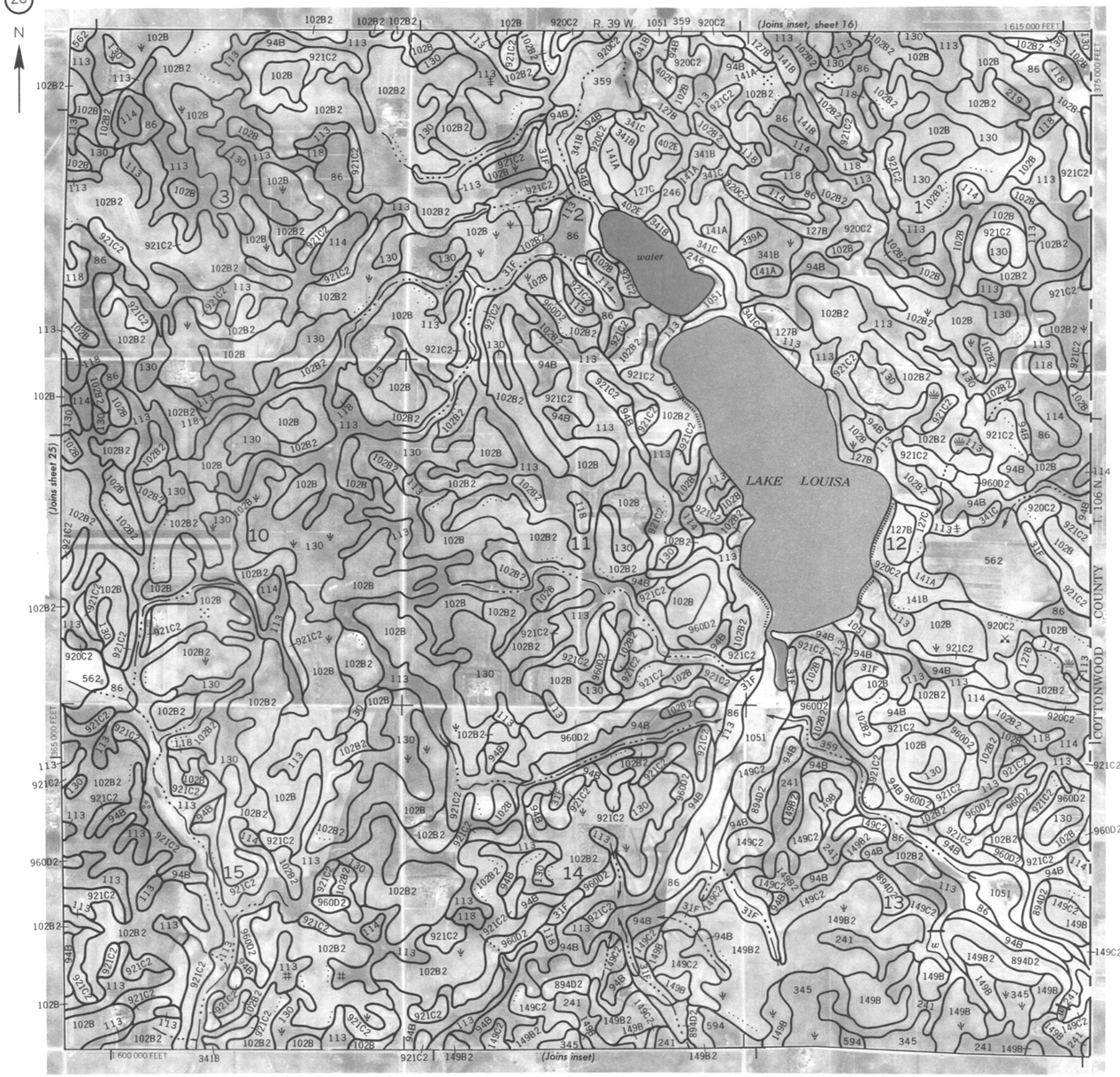

R. 43 W.
(Joins sheet 15)
(Joins sheet 22)
(Joins sheet)
BUFFALO RIDGE
Chub Creek


22
N
(Joins sheet 17)
R. 43 W.
R. 42 W.
1 500 000 FEET
375 000 FEET
(Joins sheet 21)
T. 106 N.
(Joins sheet 23)
365 000 FEET
1 475 000 FEET
(Joins sheet 27)
LAKE WILSON LAGOON
Lake Wilson
Lake Wilson
LEEDS STATE WILDLIFE MANAGEMENT AREA
PETERS STATE WILDLIFE MANAGEMENT AREA
Beaver Creek
JUDICIAL DITCH NO. 19
COUNTY DITCH NO. 29
JUDICIAL DITCH NO. 14
JUDICIAL DITCH NO. 14
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18


R. 42 W.
R. 41 W.
T. 106 N.
(Joins sheet 18)
(Joins sheet 22)
(Joins sheet 24)
(Joins sheet 28)
Hadley
Summit Lake
SLAYTON
(county seat)
SLAYTON MUNICIPAL AIRPORT
Beaver Creek
1 505 000 FEET
1 535 000 FEET
N


24
N
R. 41 W.
R. 40 W.
(Joins sheet 19)
(Joins sheet 23)
(Joins sheet 25)
(Joins sheet 29)
T. 106 N.
1 565 000 FEET
1 540 000 FEET
365 000 FEET
375 000 FEET
SLAYTON LAGOON
Beaver Creek
Elsie Lakebed
SLAYTON
(county seat)
MURRAY COUNTY FAIRGROUND
JUDICIAL DITCH NO. 10

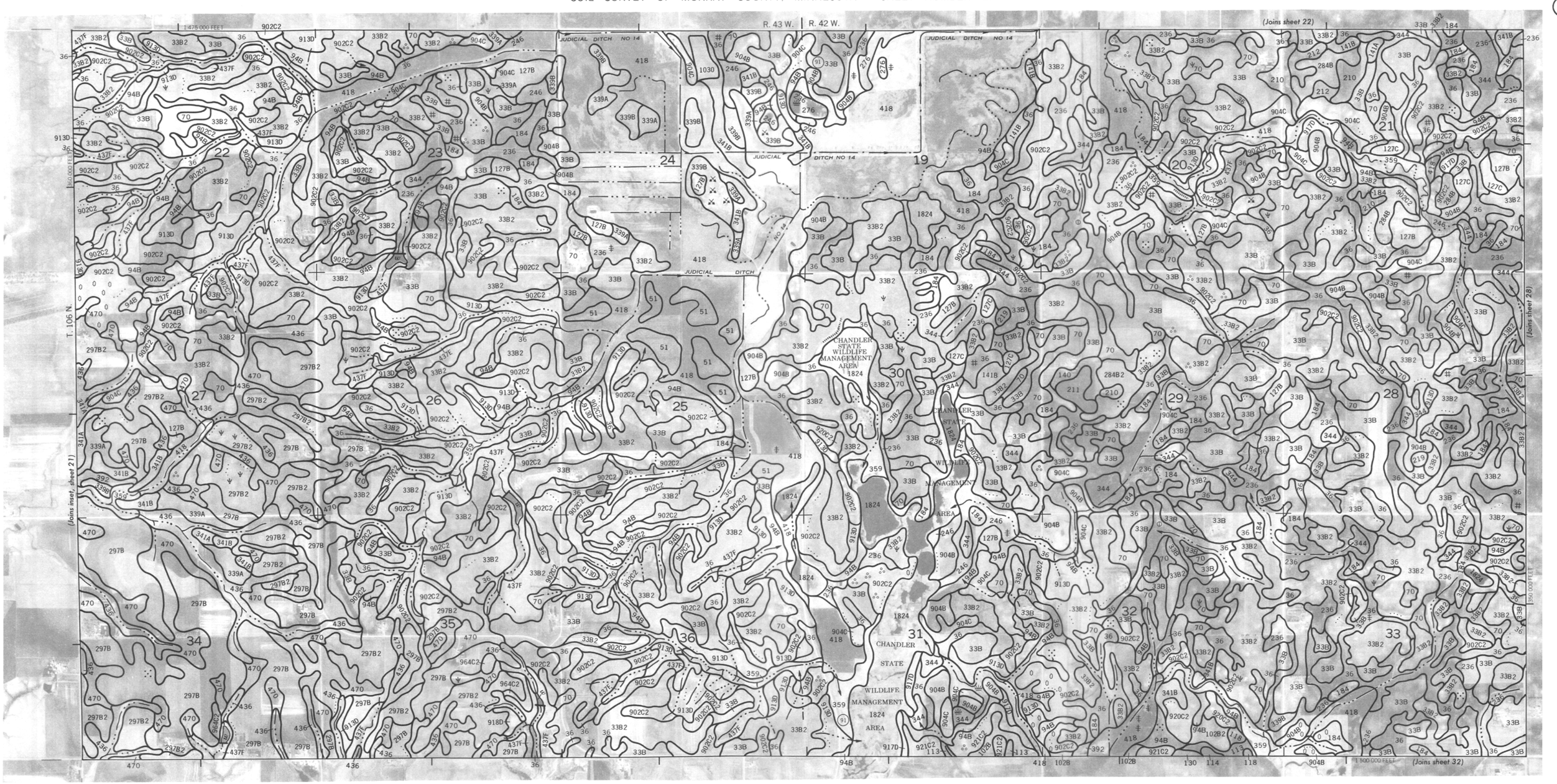

R. 40 W.
R. 39 W.
T. 106 N.
1 570 000 FEET
1 595 000 FEET
375 000 FEET
395 000 FEET
(Joins sheet 20)
(Joins sheet 24)
(Joins sheet 26)
(Joins sheet 30)
PHELAN STATE WILDLIFE MANAGEMENT AREA
DEVILS RUN STATE WILDLIFE MANAGEMENT AREA
Des Moines River
Devils Run
water
N

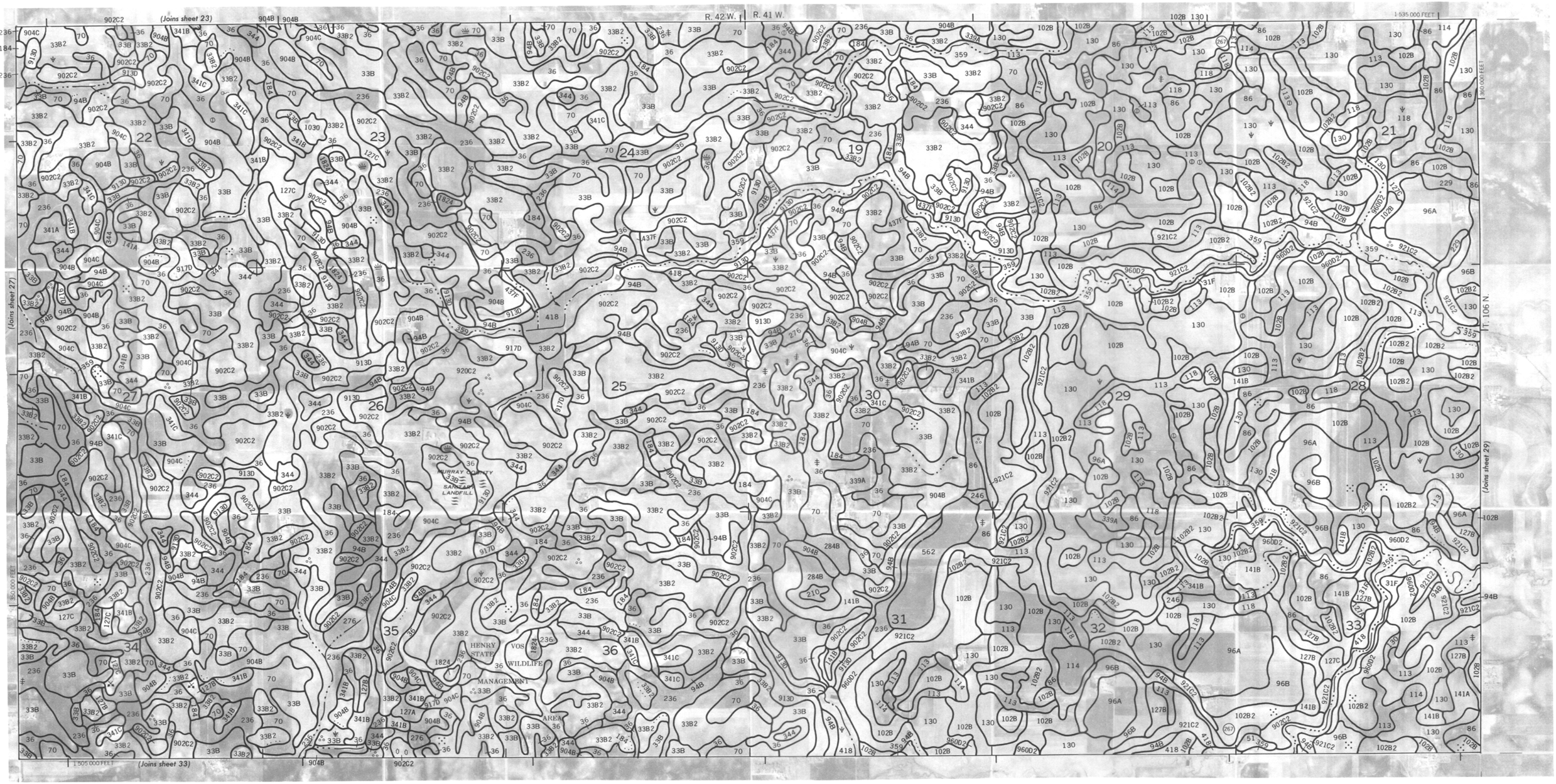

26
N
R. 39 W.
(Joins inset, sheet 16)
(Joins sheet 25)
(Joins inset)
water
LAKE LOUISA
T. 106 N.
COTTONWOOD COUNTY
1 615 000 FEET
1 565 000 FEET
1 600 000 FEET

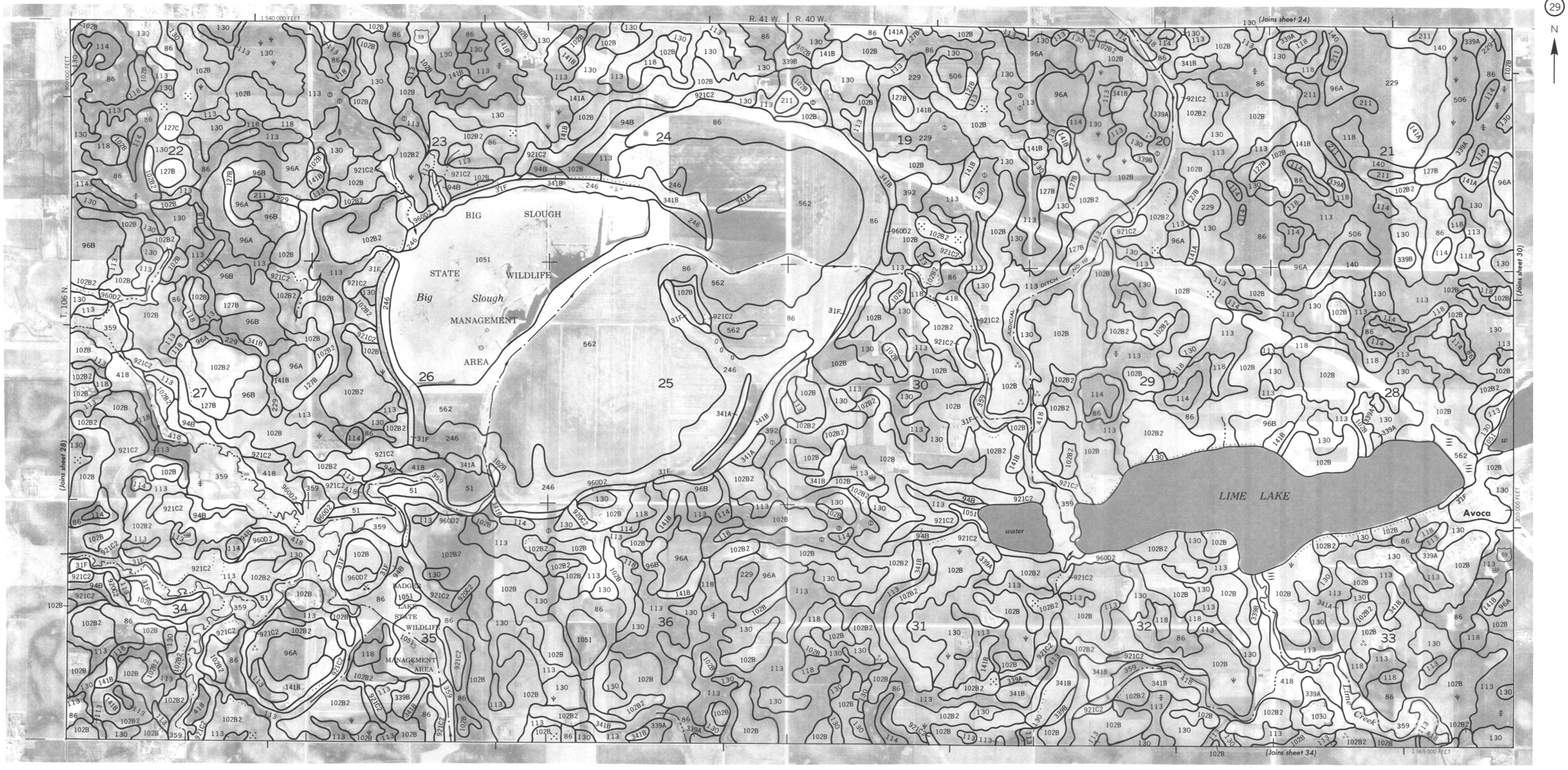

R. 39 W. (Joins lower left)
(Joins sheet 36)
Riley

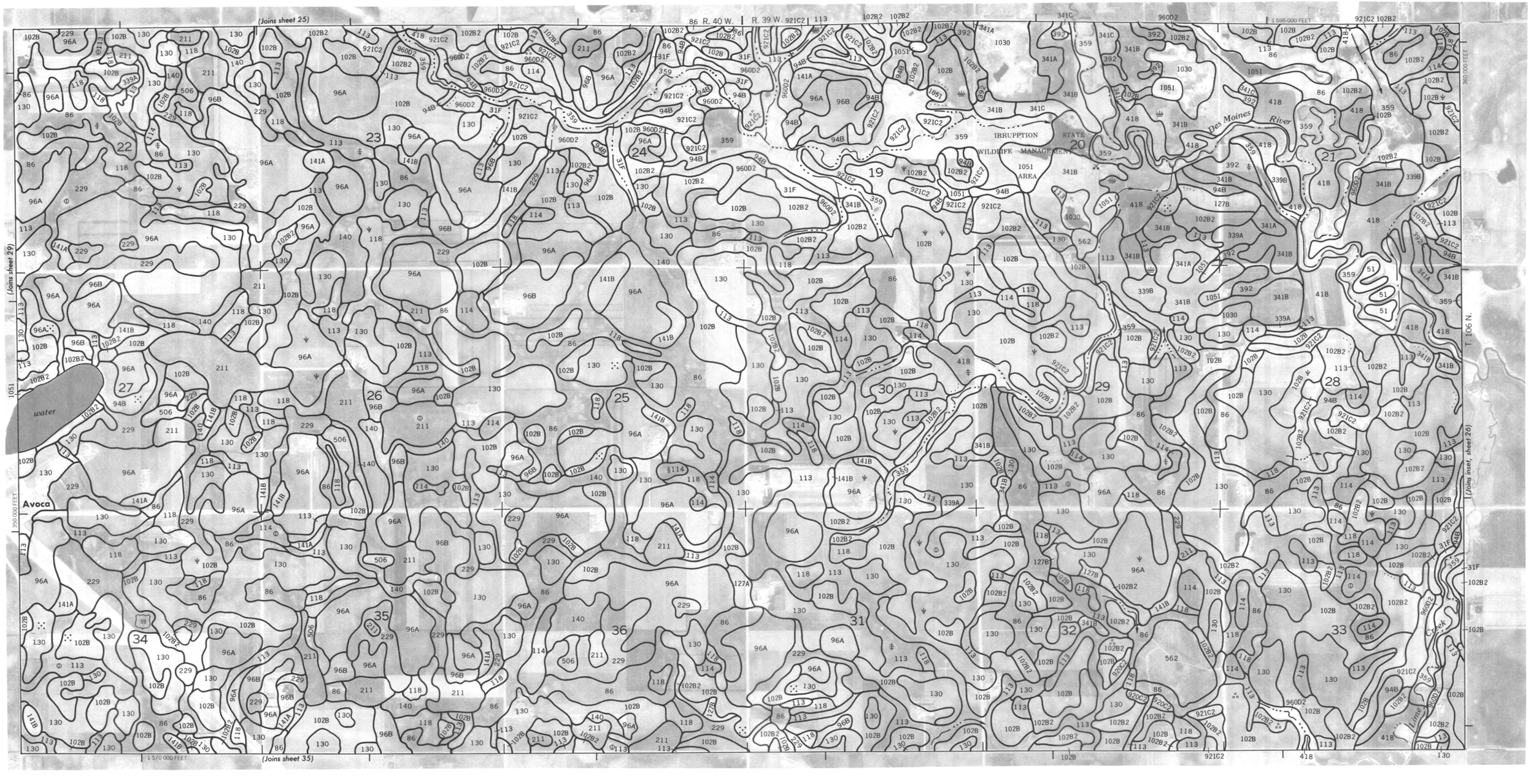

26
N
R. 39 W.
(Joins inset, sheet 16)
(Joins sheet 25)
water
LAKE LOUISA
COTTONWOOD COUNTY
T. 106 N.
(Joins inset)
1 600 000 FEET


R. 39 W. (Joins lower left)
(Joins sheet 30)
Lime Creek
Des Moines
River
COTTONWOOD COUNTY
T. 106 N.
1 615 000 FEET
380 000 FEET
345 000 FEET
1 600 000 FEET
(Joins sheet 36)

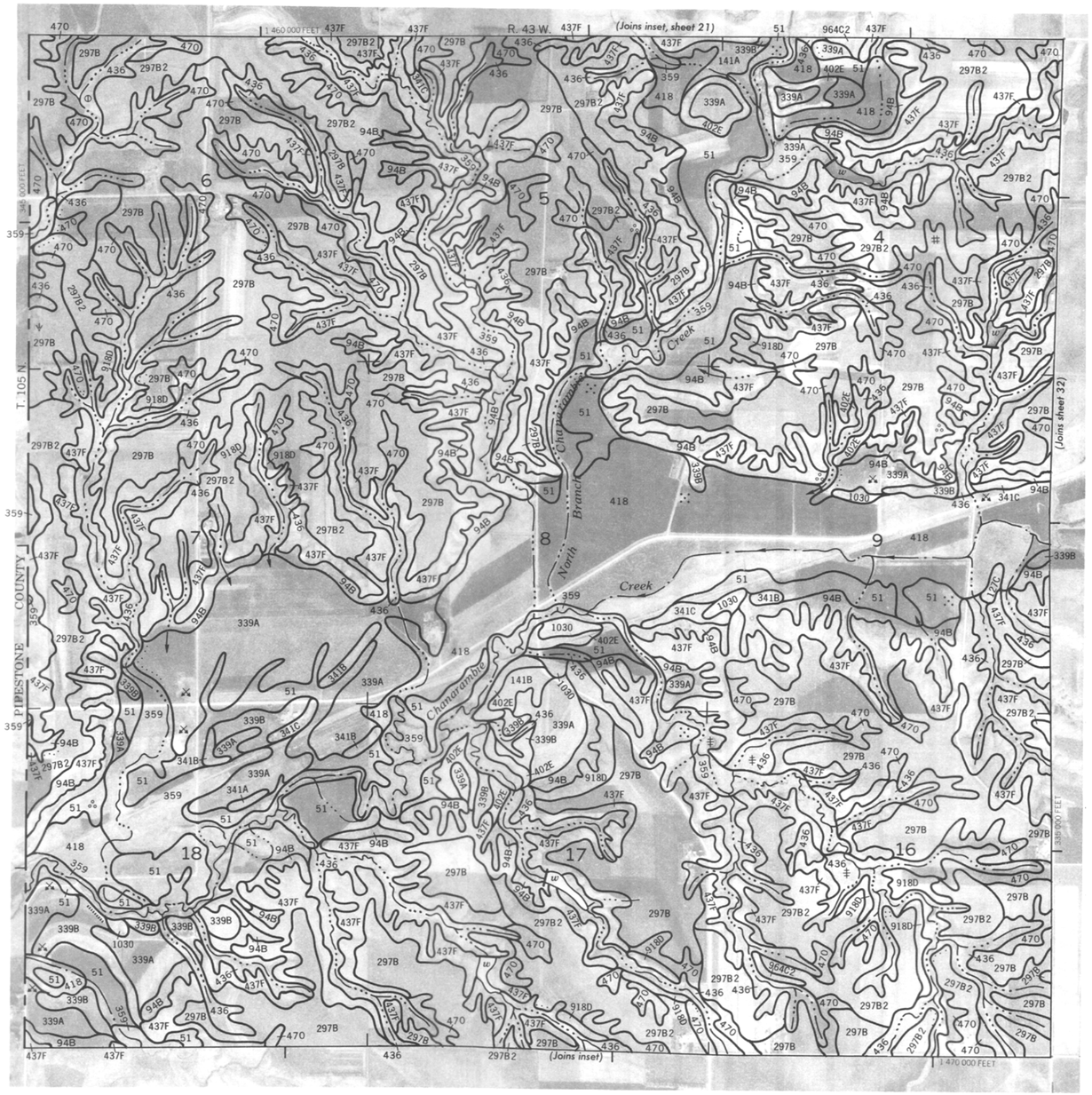

27
N
R. 43 W.
R. 42 W.
T. 106 N.
1 475 000 FEET
1 500 000 FEET
(Joins sheet 22)
(Joins inset, sheet 21)
(Joins sheet 28)
(Joins sheet 32)
JUDICIAL DITCH NO 14
JUDICIAL DITCH
CHANDLER STATE WILDLIFE MANAGEMENT AREA 1824
22
23
24
19
20
21
27
26
25
30
29
28
34
35
36
31
32
33


28
N
R. 42 W.
R. 41 W.
(Joins sheet 23)
(Joins sheet 27)
(Joins sheet 29)
(Joins sheet 33)
T. 106 N.
1 535 000 FEET
1 505 000 FEET
380 000 FEET
350 000 FEET
MURRAY COUNTY SANITARY LANDFILL
HENRY VOS STATE WILDLIFE MANAGEMENT AREA


1 540 000 FEET
R. 41 W.
R. 40 W.
(Joins sheet 24)
960000 FEET
T. 106 N.
(Joins sheet 28)
(Joins sheet 30)
(Joins sheet 34)
1 565 000 FEET
350 000 FEET
N
BIG SLOUGH
STATE WILDLIFE
Big Slough
MANAGEMENT
AREA
BADGER LAKE STATE WILDLIFE MANAGEMENT AREA
LIME LAKE
water
Avoca
Time Creek
113 DITCH
JUDICIAL DITCH NO. 10
22
23
24
25
26
27
19
20
21
29
28
30
31
32
33
34
35
36

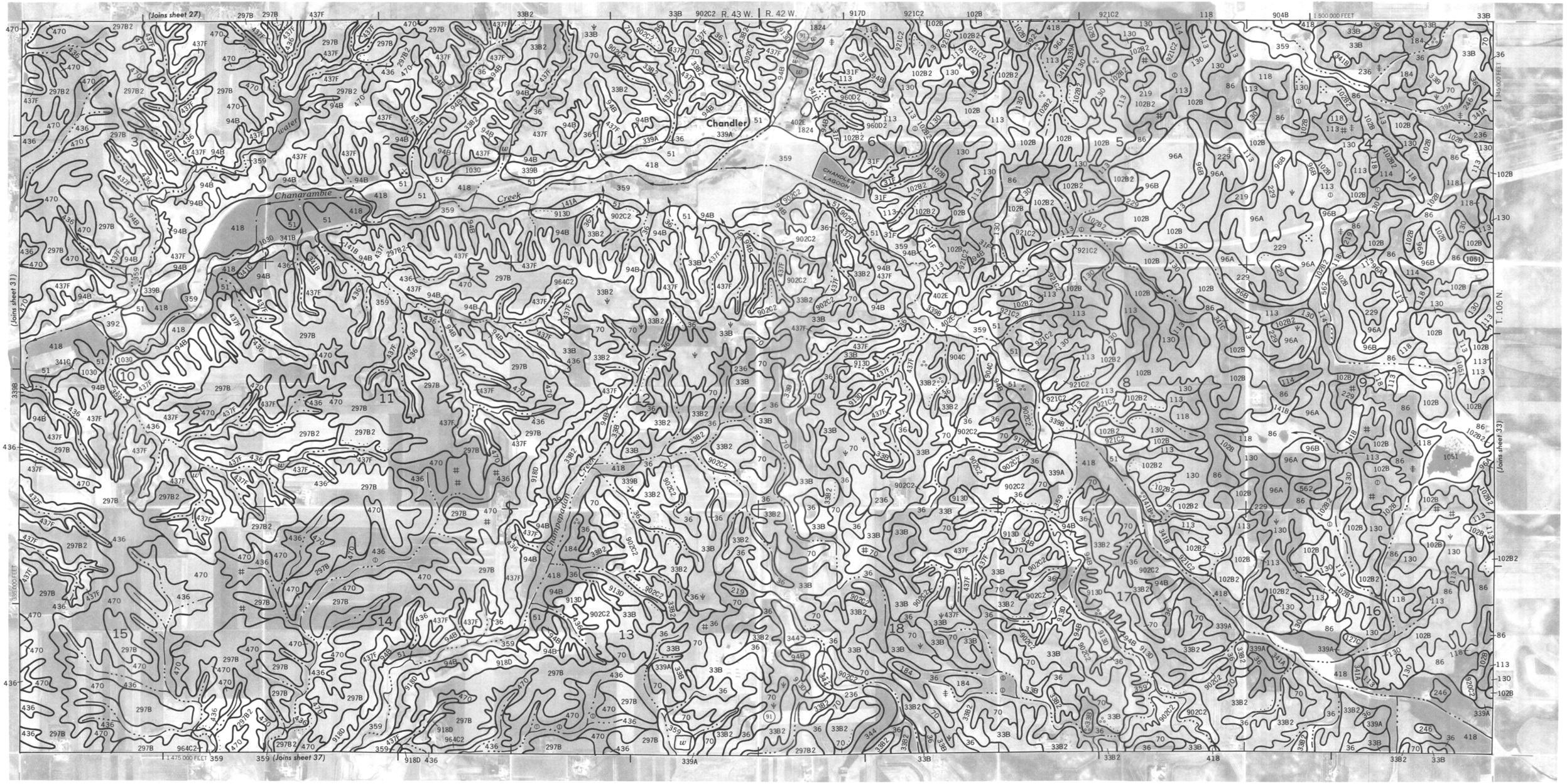

30
N
(Joins sheet 25)
86 R. 40 W.
R. 39 W.
1 595 000 FEET
360 000 FEET
(Joins sheet 29)
1051
water
Avoca
350 000 FEET
1 570 000 FEET
(Joins sheet 35)
IRRUPTION
STATE
WILDLIFE MANAGEMENT
AREA
Des Moines River
T. 106 N.
(Joins inset, sheet 26)
Lime Creek
22
23
24
19
20
21
27
26
25
30
29
28
34
35
36
31
32
33


R. 43 W.
(Joins lower right)
(Joins sheet 37)
T. 105 N.
PIPESTONE COUNTY
ROCK COUNTY
NOBLES COUNTY

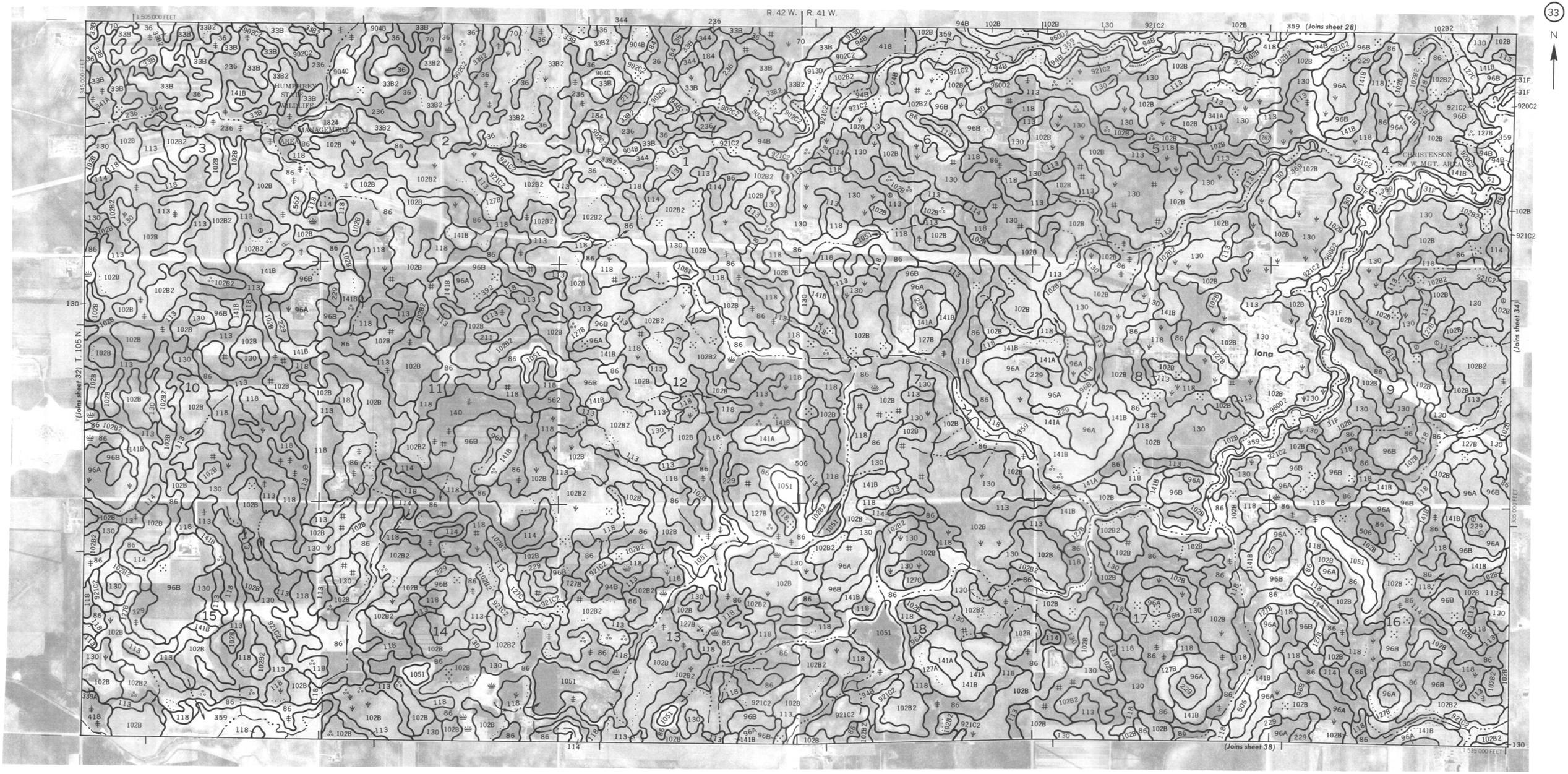

R. 43 W.
(Joins inset, sheet 21)
(Joins sheet 32)
(Joins inset)
T. 105 N.
PIPESTONE COUNTY
1 460 000 FEET
1 470 000 FEET
Chanaranbie Creek
North Branch Chanaranbie Creek

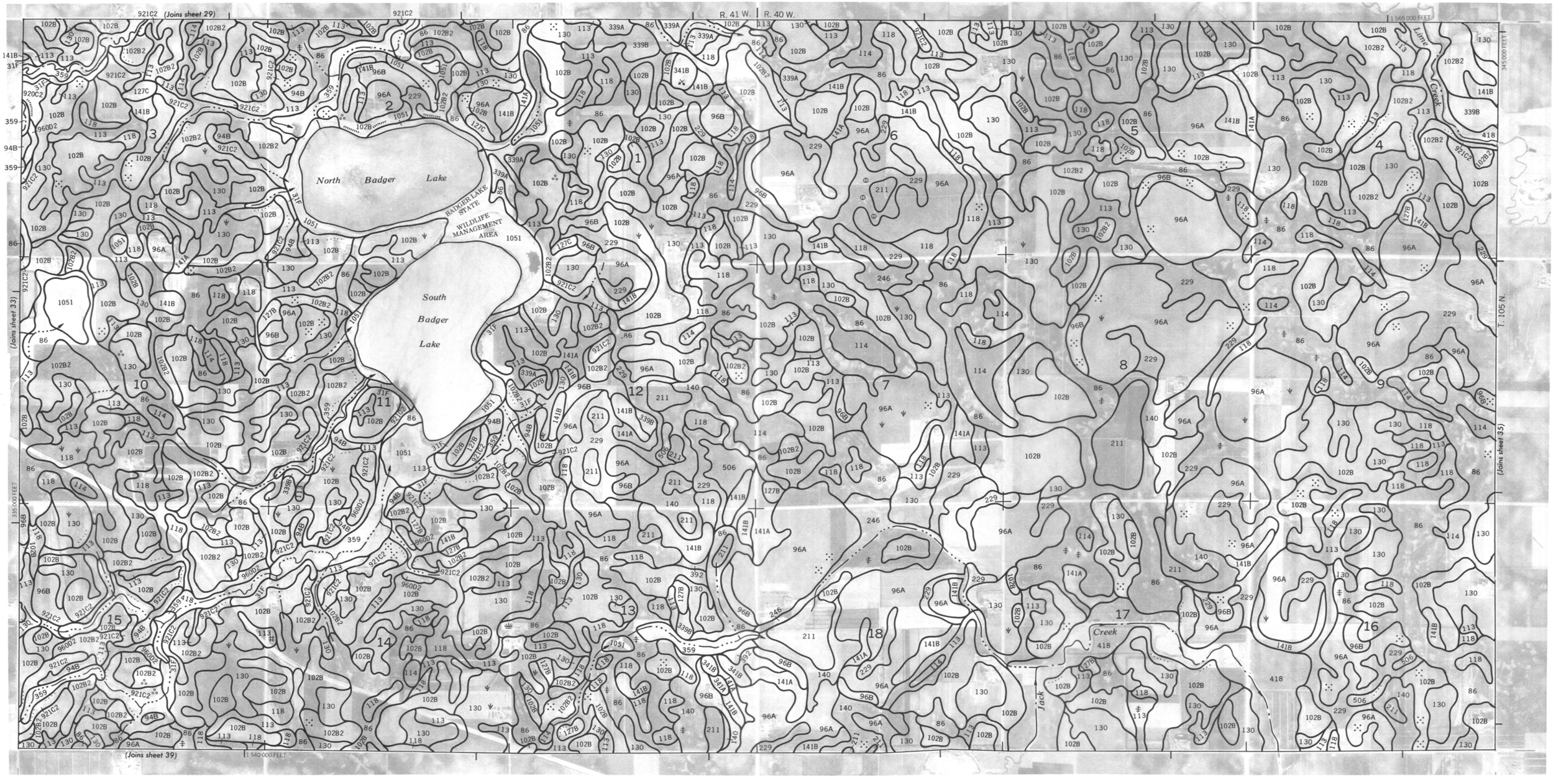
N

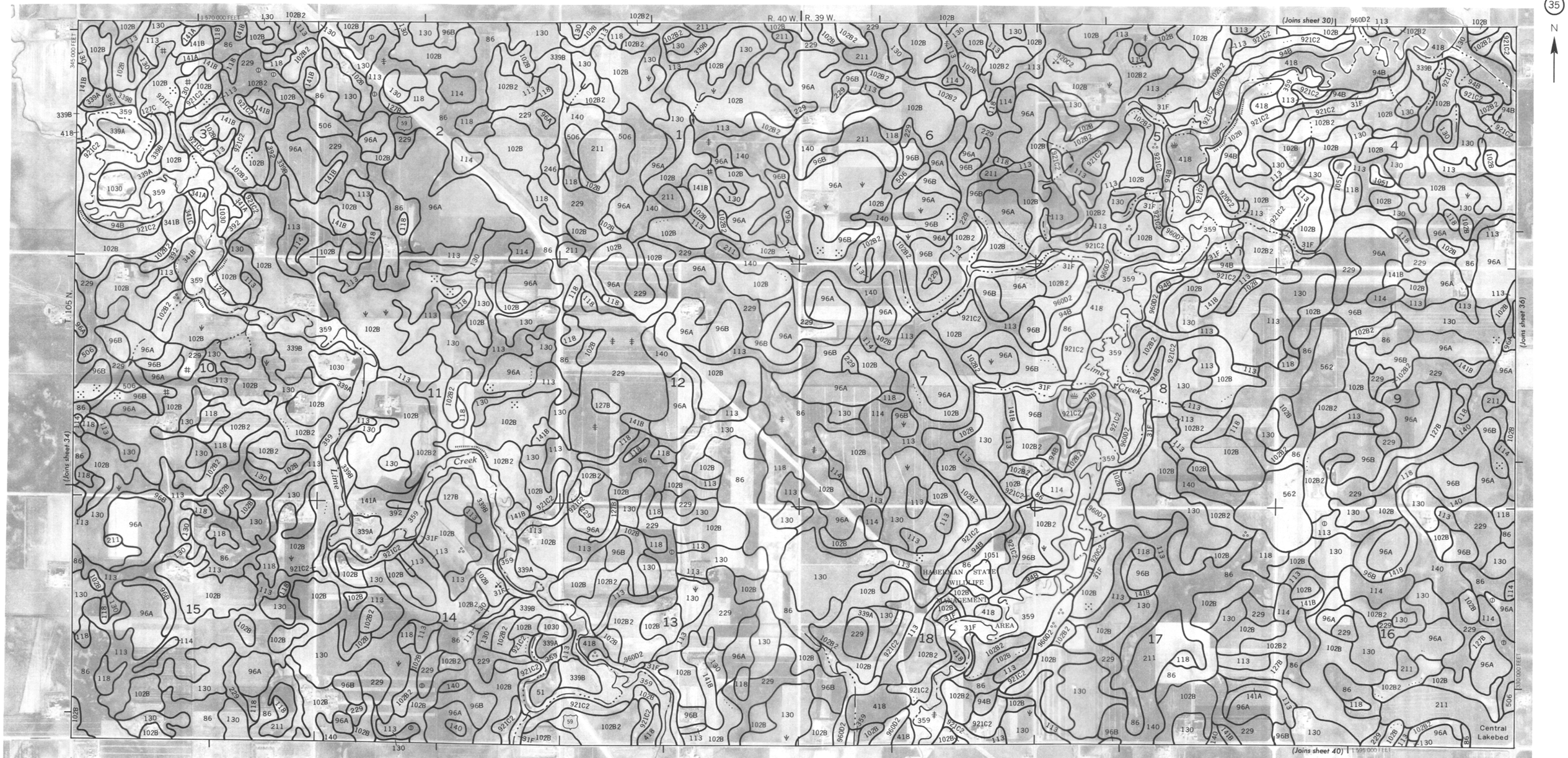

R. 43 W.
(Joins lower right)
(Joins sheet 37)
(Joins inset, sheet 21)
(Joins sheet 32)
(Joins inset)
T. 105 N.
PIPESTONE COUNTY
ROCK COUNTY
NOBLES COUNTY
1 460 000 FEET
1 470 000 FEET
30 000 FEET
20 000 FEET
North Branch Chanarambie Creek
N

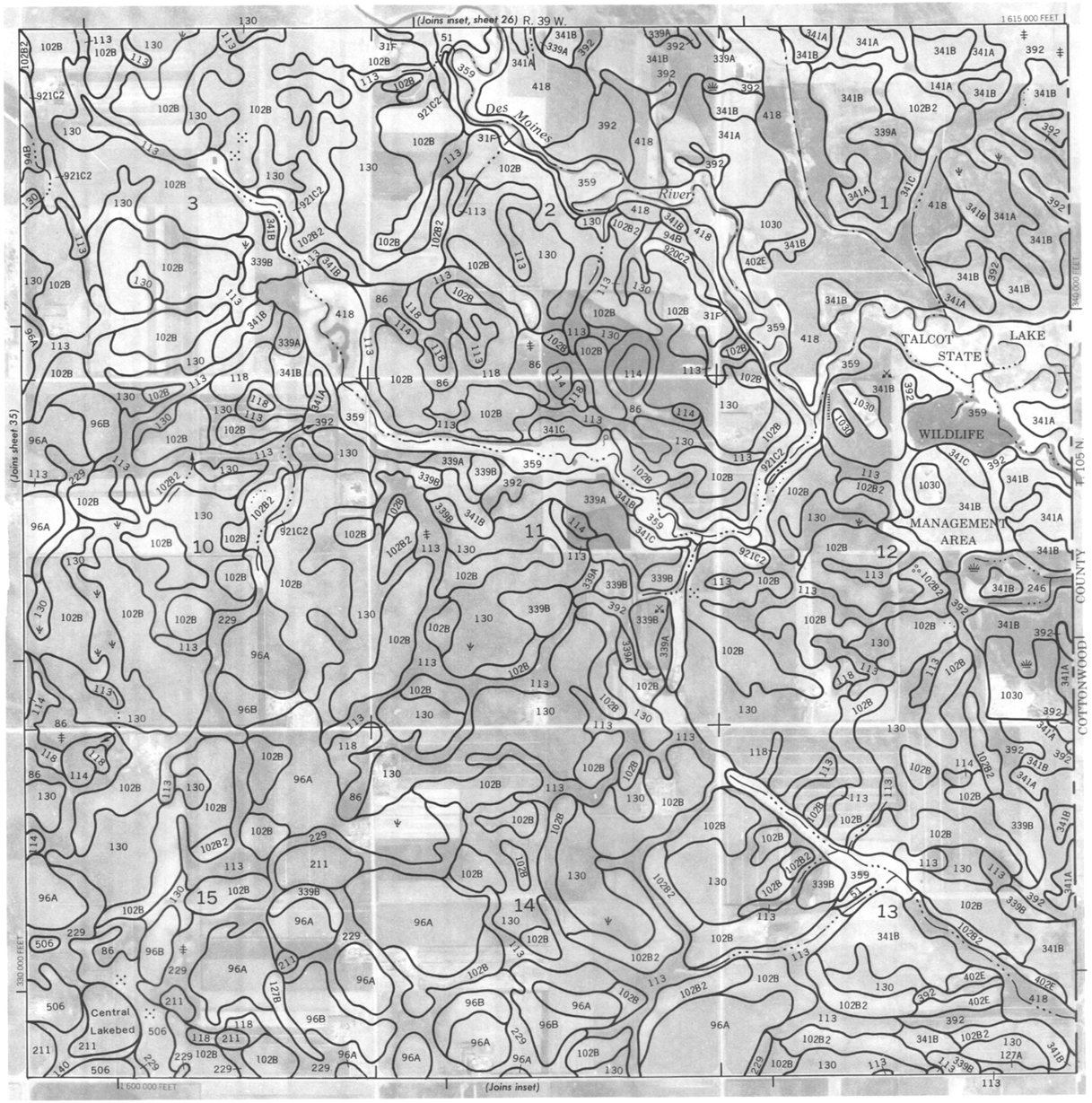

32
N
(Joins sheet 27)
R. 43 W.
R. 42 W.
Chandler
CHANDLER LAGOON
Chanarambie Creek
Champepadan Creek
(Joins sheet 31)
(Joins sheet 33)
(Joins sheet 37)
T. 105 N.
1 500 000 FEET
1 475 000 FEET
345 000 FEET
338 000 FEET

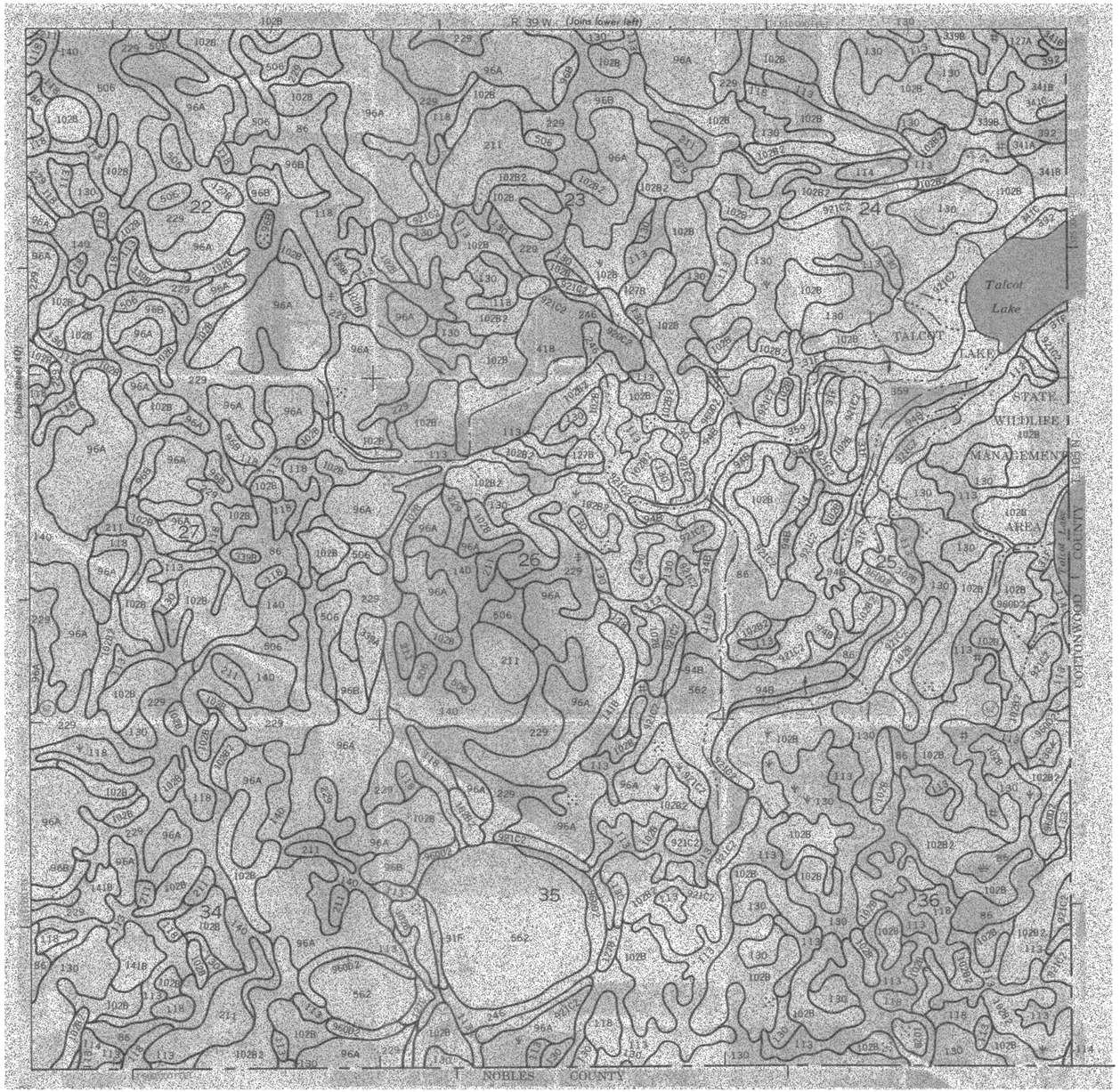
SOIL SURVEY OF MURRAY COUNTY, MINNESOTA - SHEET NUMBER 33



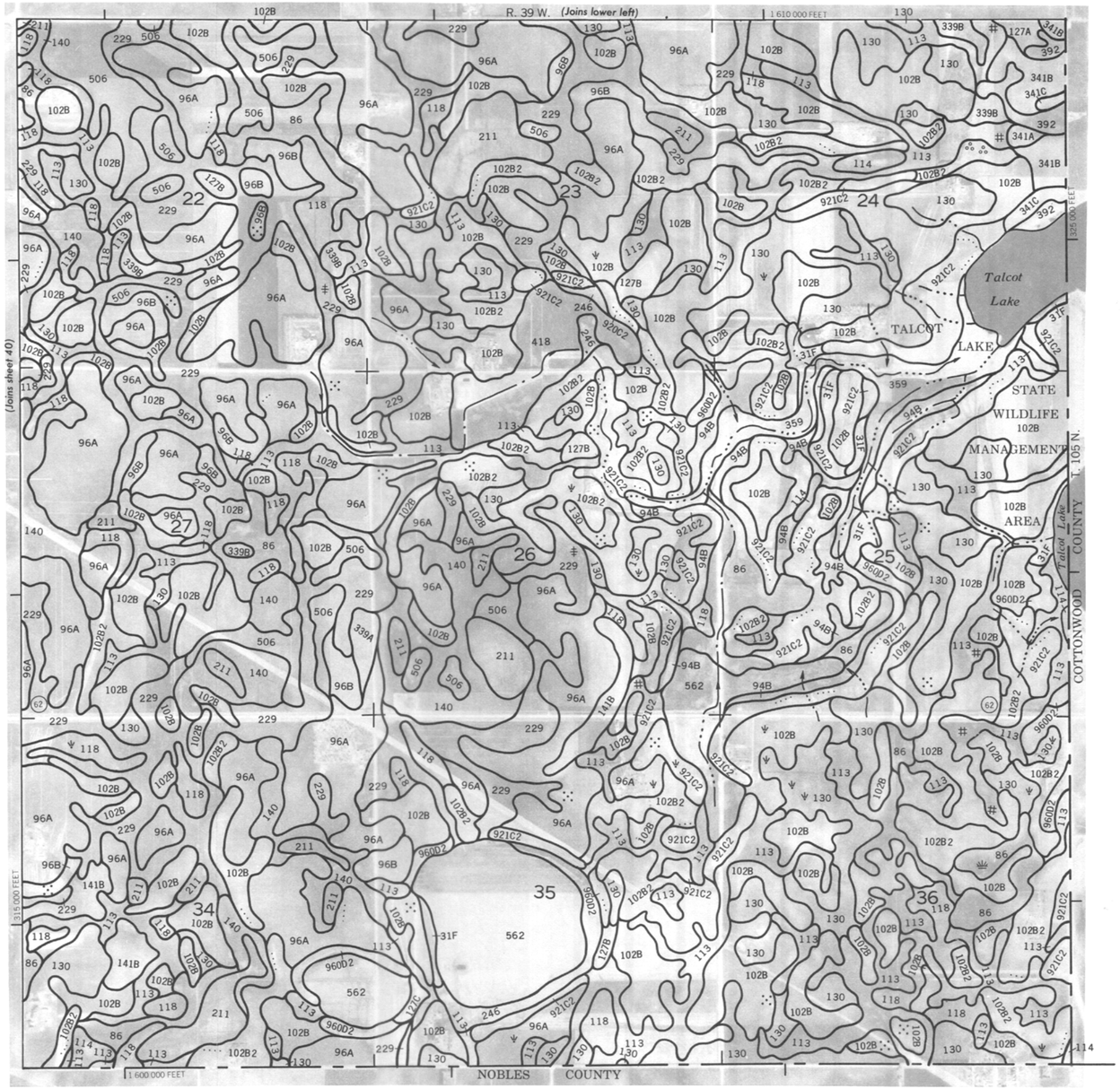

34
N
R. 41 W.
R. 40 W.
T. 105 N.
North Badger Lake
South Badger Lake
BADGER LAKE STATE WILDLIFE MANAGEMENT AREA
Lime Creek
Jack Creek
(Joins sheet 29)
(Joins sheet 33)
(Joins sheet 35)
(Joins sheet 39)
1 565 000 FEET
1 540 000 FEET
345 000 FEET
335 000 FEET

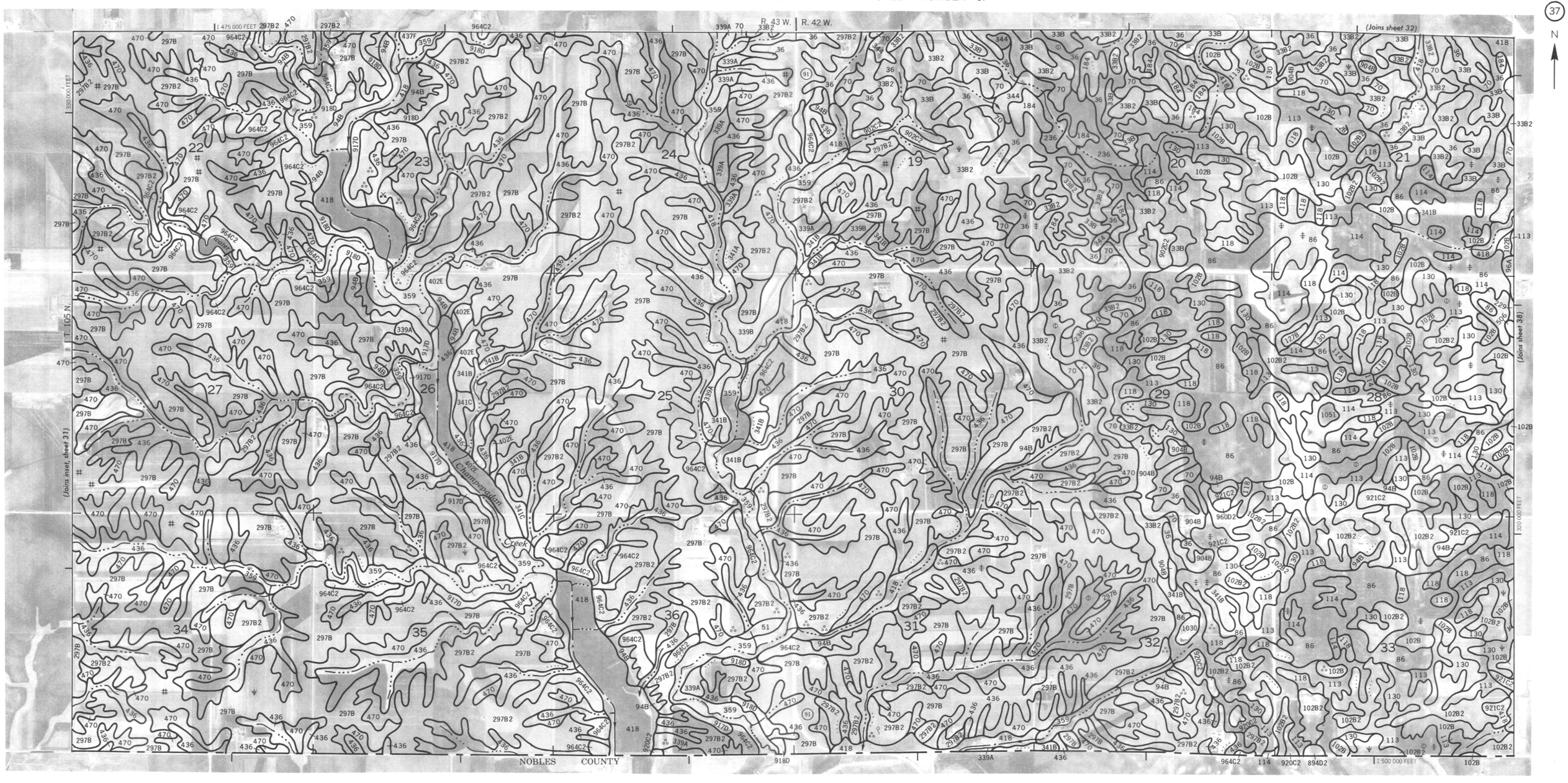

R. 40 W.
R. 39 W.
T. 105 N.
(Joins sheet 30)
(Joins sheet 34)
(Joins sheet 36)
(Joins sheet 40)
Lime Creek
HABERMAN STATE WILDLIFE MANAGEMENT AREA
Central Lakebed
N

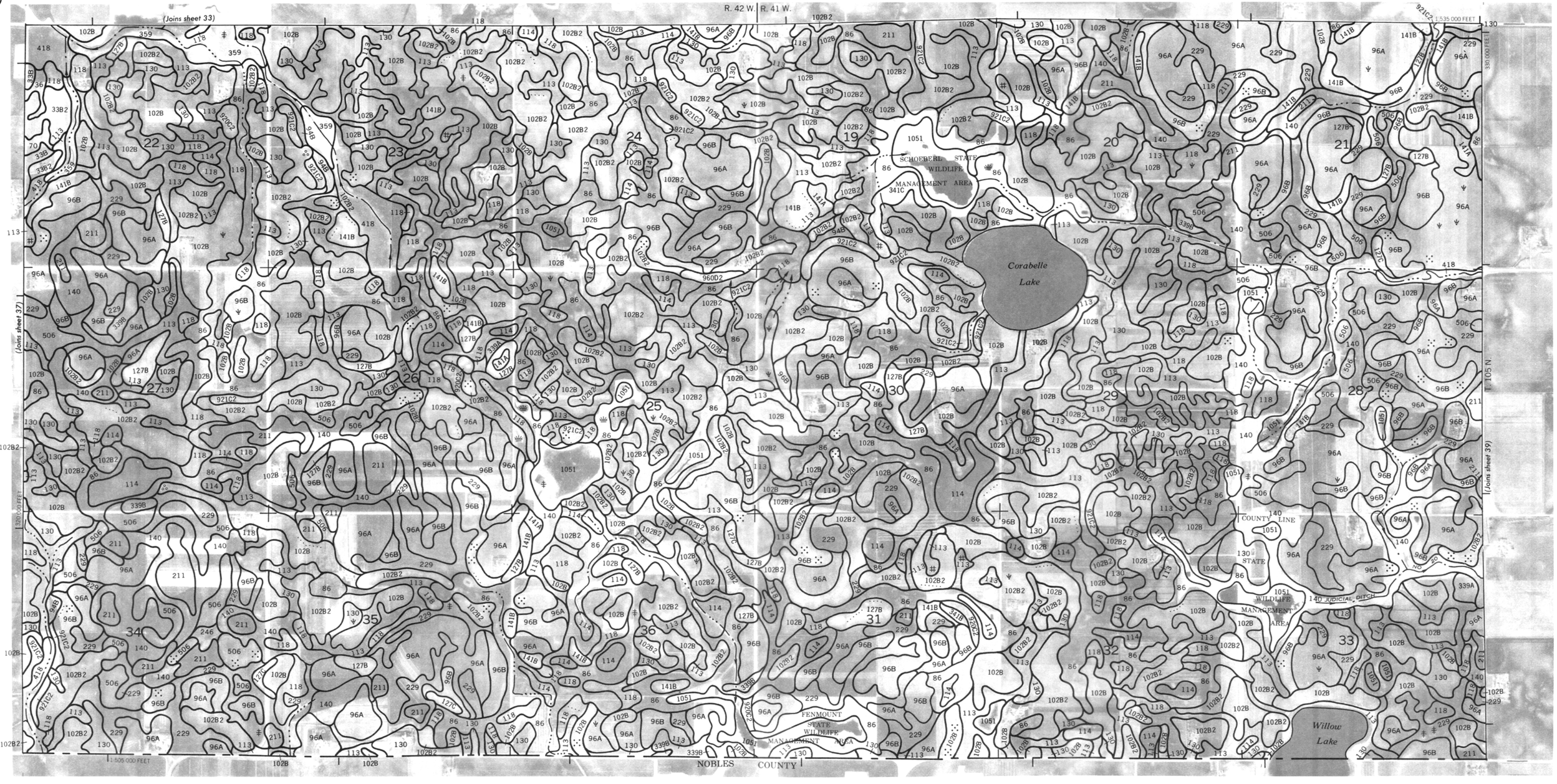

N
(Joins inset, sheet 26) R. 39 W.
1 615 000 FEET
Des Moines River
TALCOT LAKE STATE WILDLIFE MANAGEMENT AREA
Central Lakebed
(Joins sheet 35)
(Joins inset)
1 600 000 FEET
COTTONWOOD COUNTY

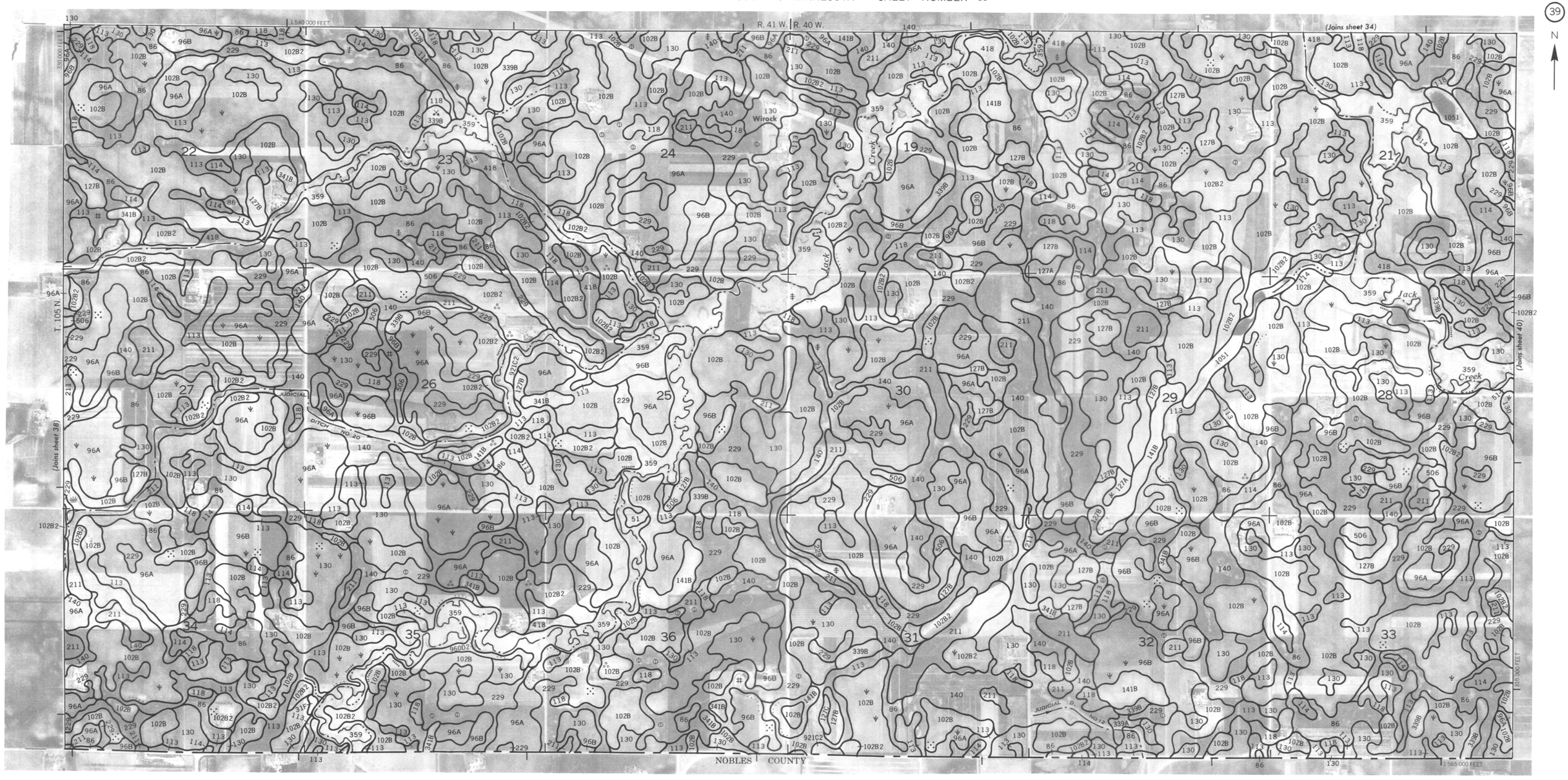

R. 39 W. (Joins lower left)
Talcot Lake
TALCOT LAKE STATE WILDLIFE MANAGEMENT AREA
(Joins sheet 40)
NOBLES COUNTY

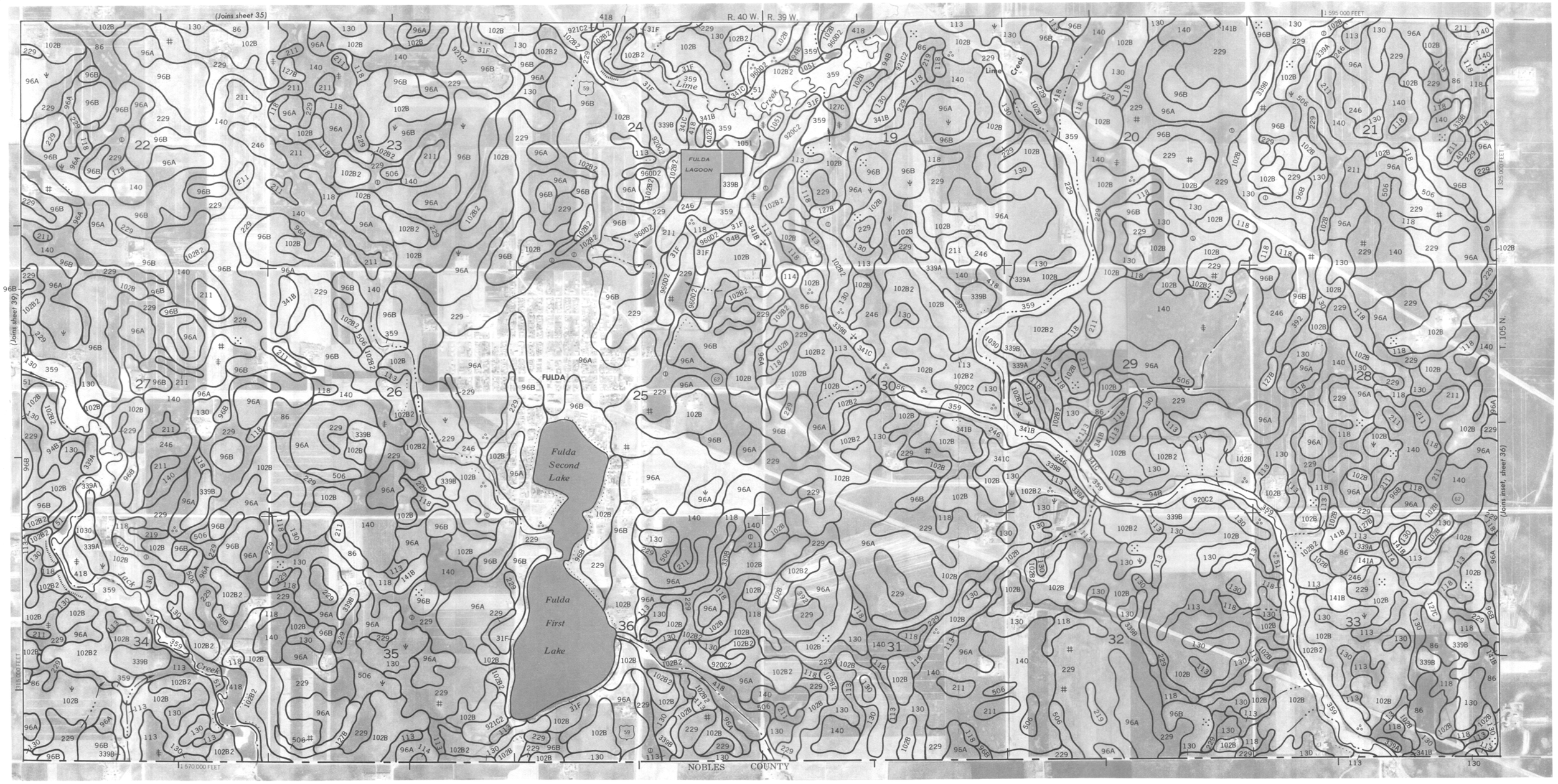

36
N
(Joins inset, sheet 26) R. 39 W.
(Joins sheet 25)
TALCOT LAKE STATE WILDLIFE MANAGEMENT AREA
Central Lakebed
(Joins inset)


R. 39 W. (Joins lower left)
1 610 000 FEET
(Joins sheet 40)
Talcot Lake
TALCOT LAKE STATE WILDLIFE MANAGEMENT AREA
COTTONWOOD COUNTY
T. 105 N.
1 615 000 FEET
1 600 000 FEET
NOBLES COUNTY


R. 43 W.
R. 42 W.
(Joins sheet 32)
(Joins inset, sheet 31)
(Joins sheet 38)
T. 105 N.
1 475 000 FEET
1 500 000 FEET
320 000 FEET
Champepadan Creek
NOBLES COUNTY
N


38
N
R. 42 W.
R. 41 W.
(Joins sheet 33)
(Joins sheet 37)
(Joins sheet 39)
T. 105 N.
1 505 000 FEET
1 535 000 FEET
330 000 FEET
320 000 FEET
Corabelle Lake
Willow Lake
SCHOEBERL STATE WILDLIFE MANAGEMENT AREA
FENMOUNT STATE WILDLIFE MANAGEMENT AREA
COUNTY LINE
STATE JUDICIAL DITCH NO. 40
NOBLES COUNTY


R. 41 W.
R. 40 W.
1,540,000 FEET
330,000 FEET
(Joins sheet 34)
(Joins sheet 38)
(Joins sheet 40)
T. 105 N.
Wirock Creek
Jack Creek
Jack Creek
JUDICIAL DITCH NO. 20
JUDICIAL DITCH NO. 12
NOBLES COUNTY
1,565,000 FEET
330,000 FEET
N


40
N
(Joins sheet 35)
R. 40 W.
R. 39 W.
1 595 000 FEET
(Joins sheet 39)
T. 105 N.
(Joins inset, sheet 36)
1 570 000 FEET
NOBLES COUNTY
FULDA LAGOON
FULDA
Fulda Second Lake
Fulda First Lake
Lime Creek
Jack Creek
22
23
24
19
20
21
27
26
25
30
29
28
34
35
36
31
32
33